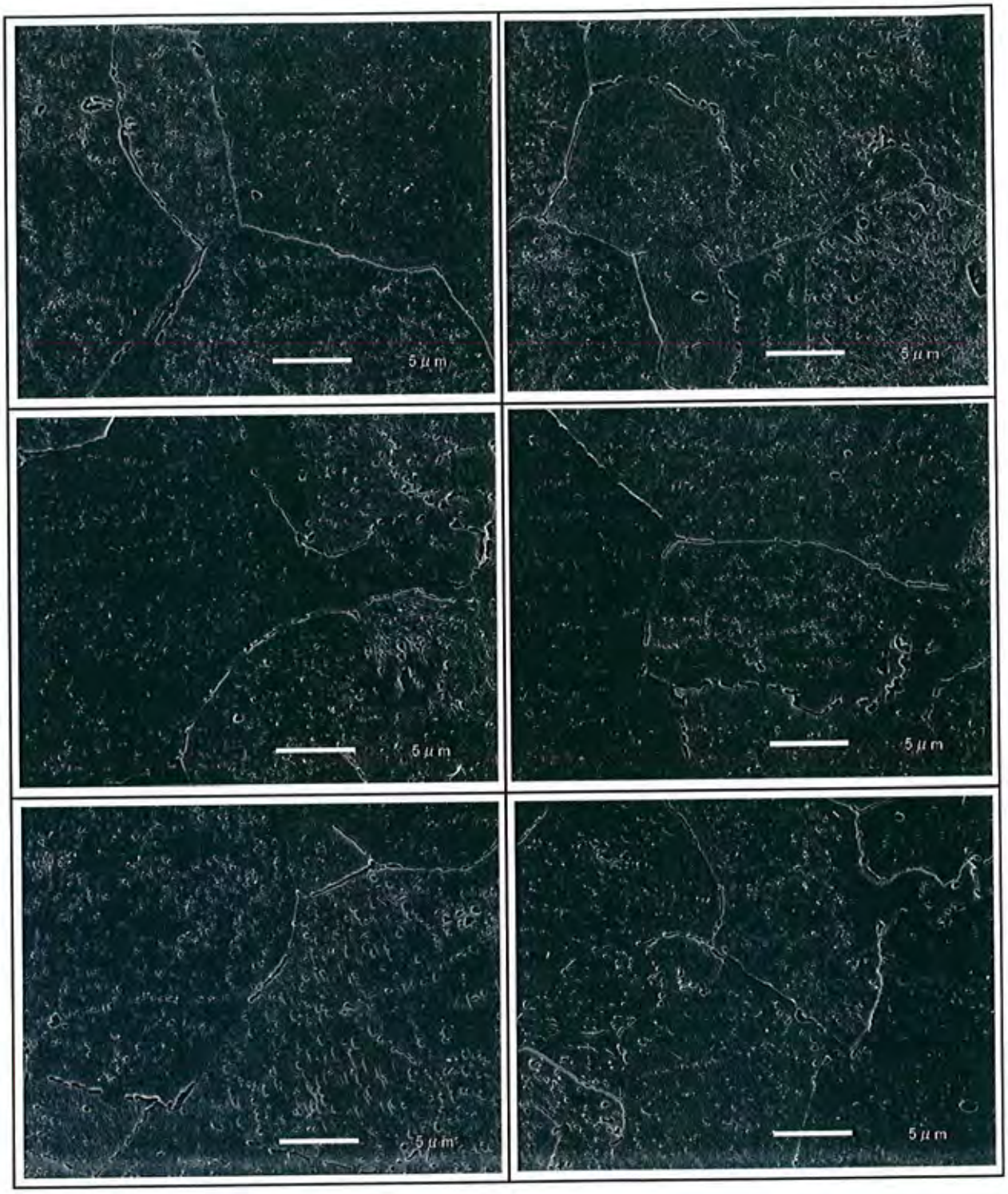


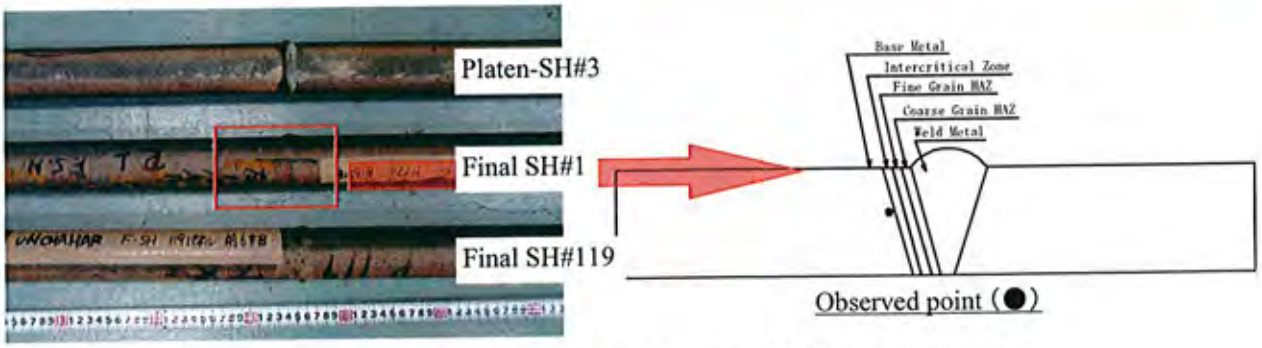
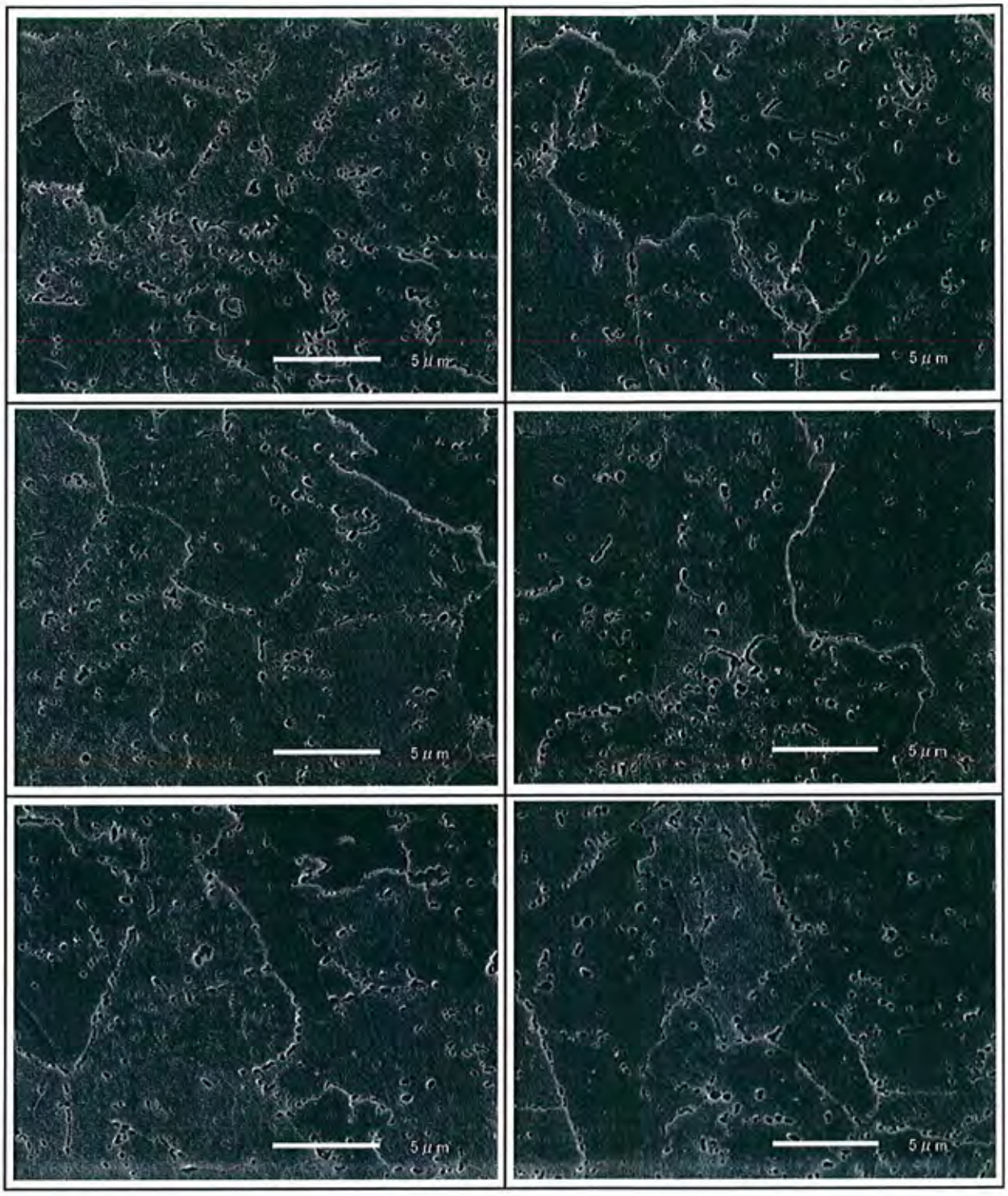


Photo II -44 Precipitates along grain boundary by SEM observation
〔Final-SH #1 (Base Metal)〕



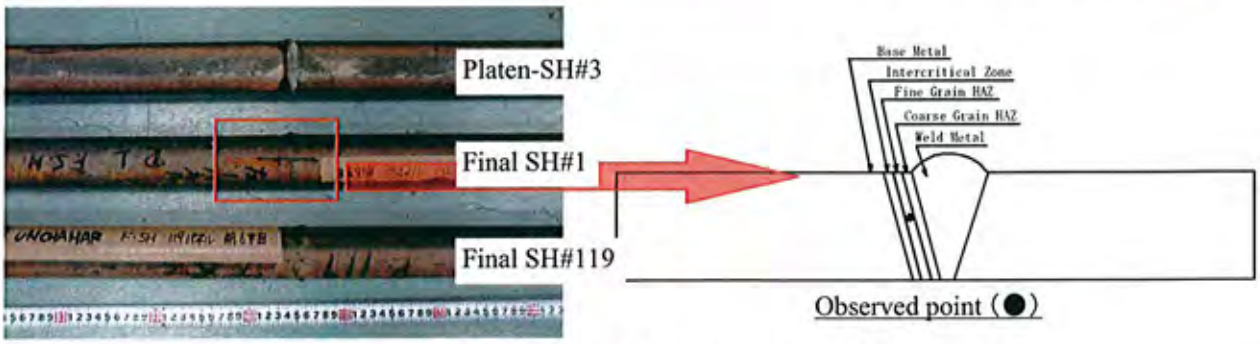


Photo II -45 Precipitates along grain boundary by SEM observatior
〔Final-SH #1 (Fine Grain HAZ) 〕

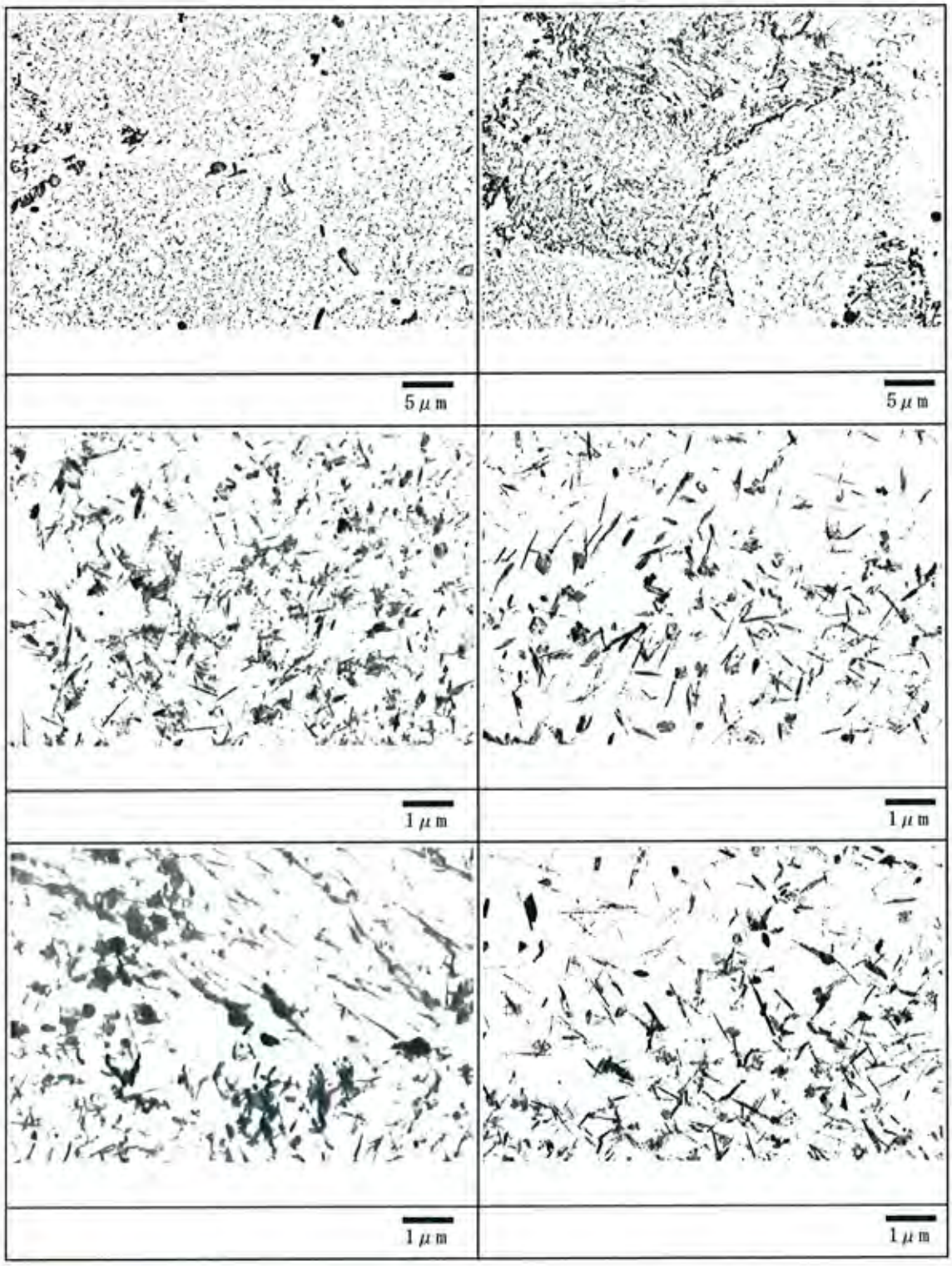
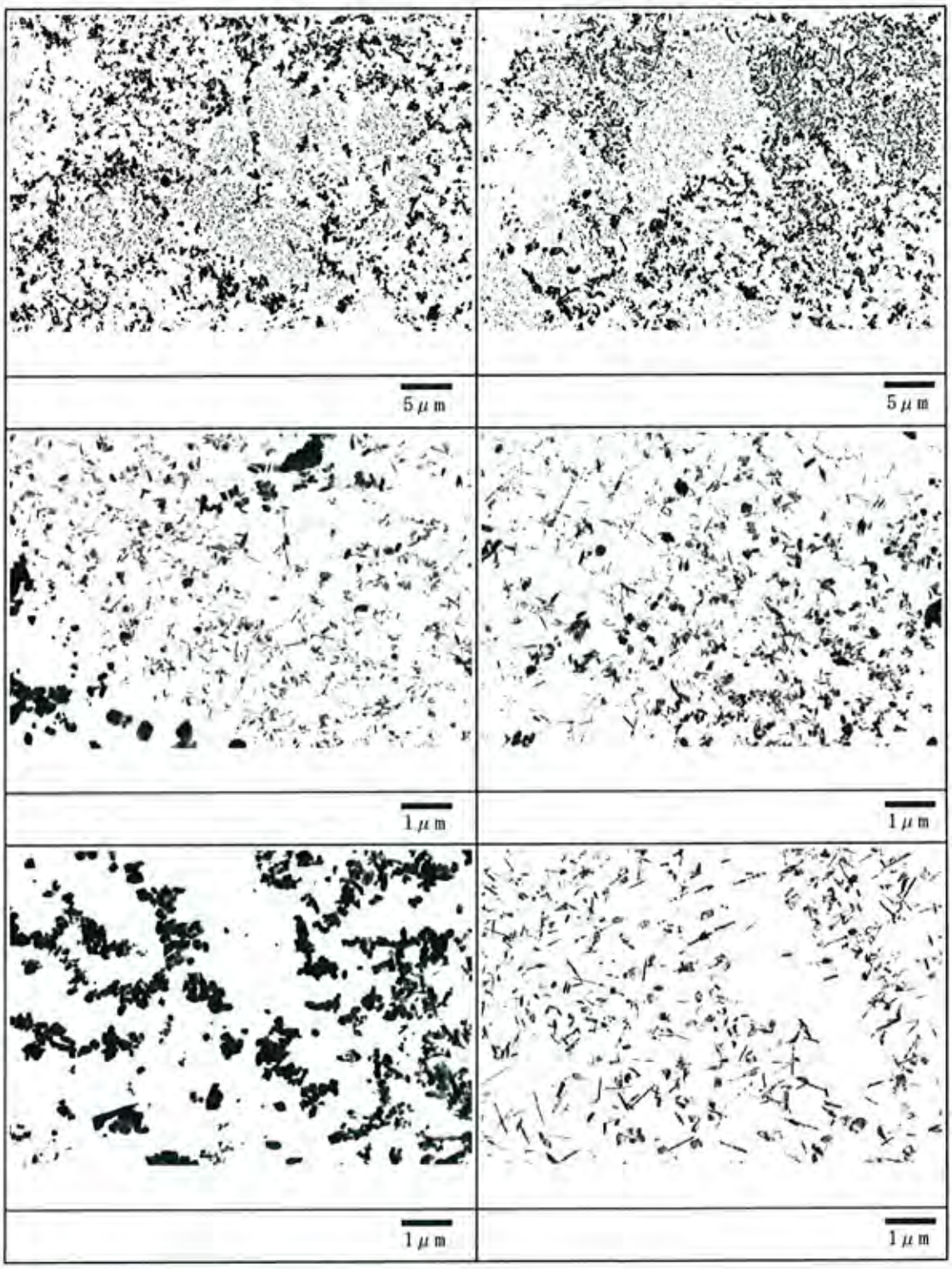


Photo II -46 Precipitates distribution by TEM observation〔Final-SH #1 (Base Metal)〕



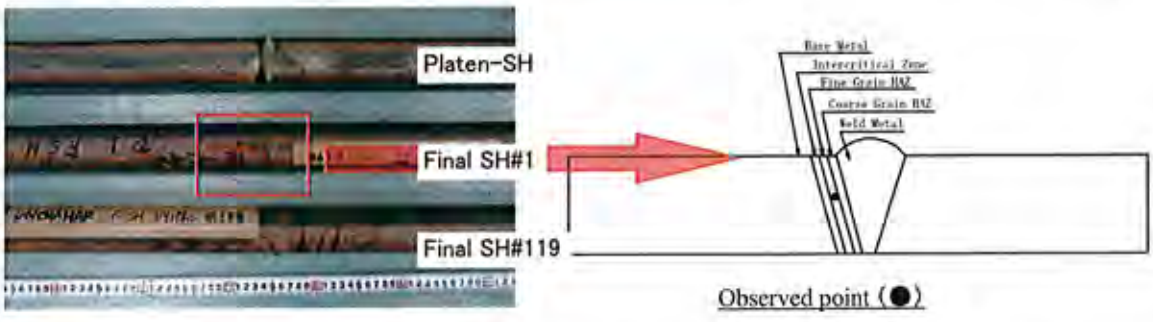
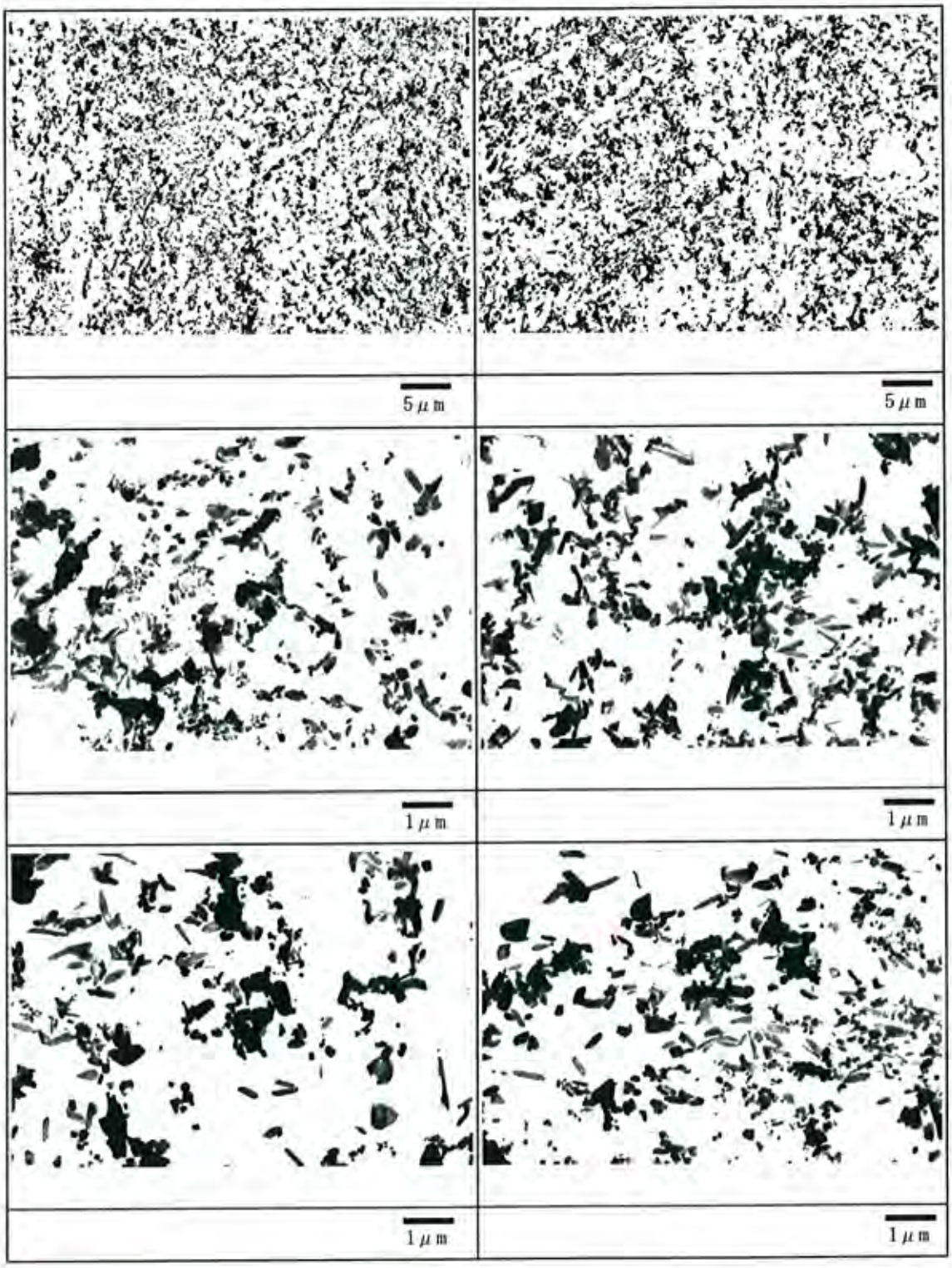


Photo II -47 Precipitates distribution by TEM observation〔Final-SH #1 (Fine Grain HAZ) 〕



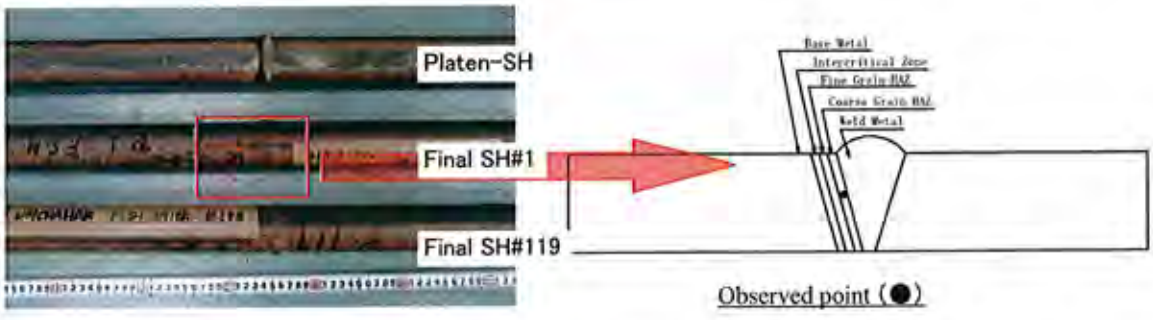


Photo II -48 Precipitates distribution by TEM observation〔Final-SH #1 (Coarse Grain HAZ) 〕

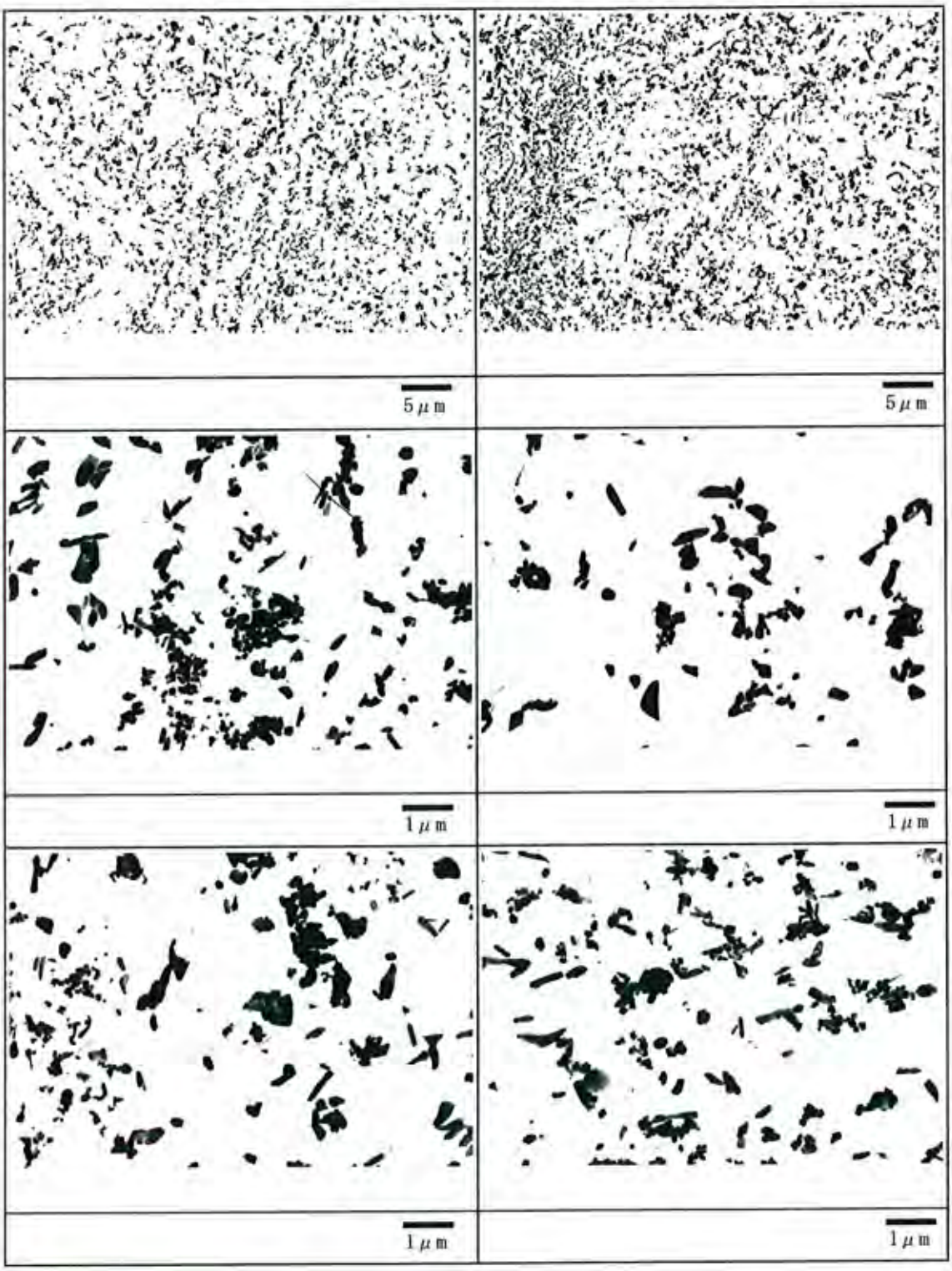
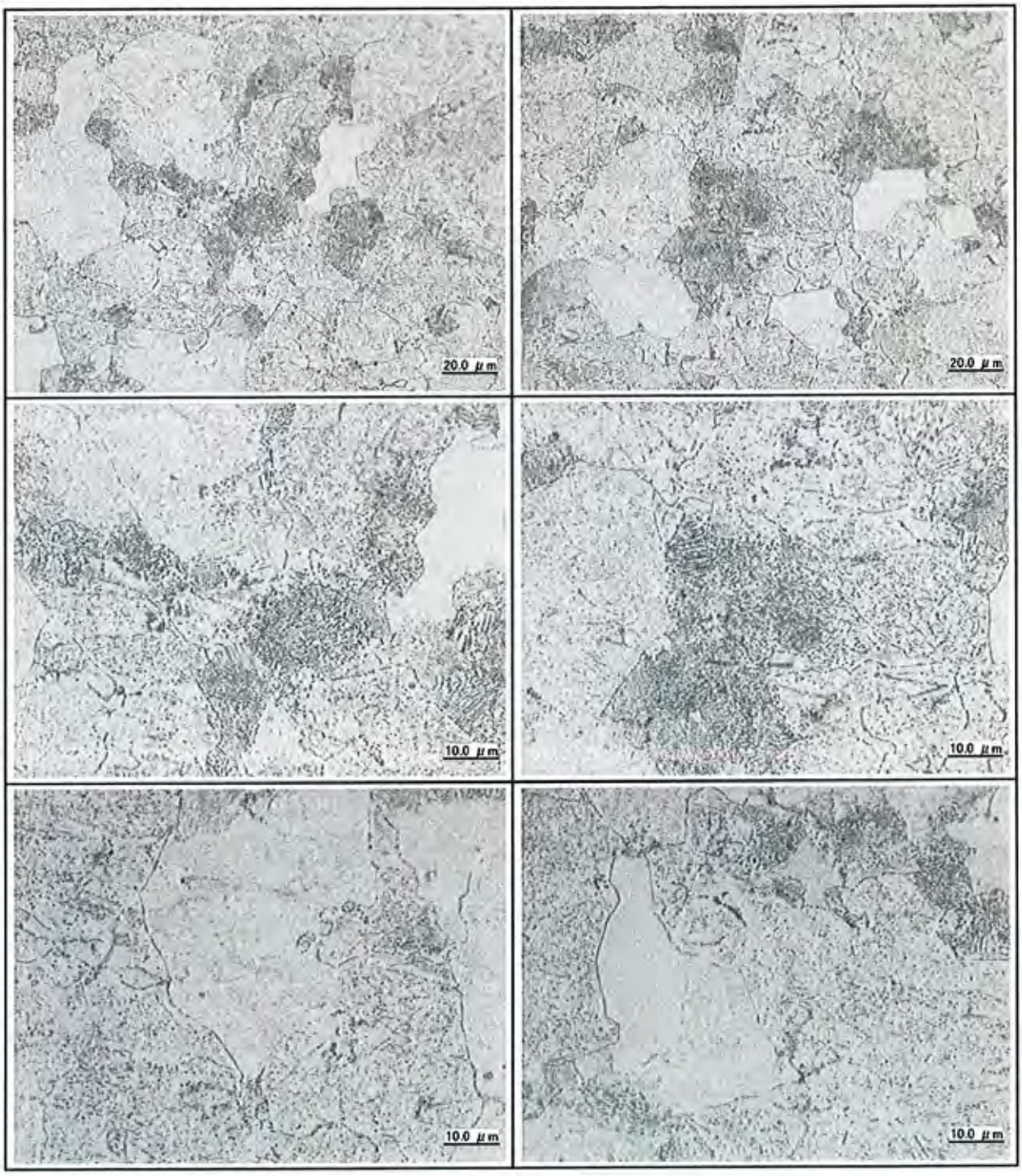


Photo II -49 Precipitates distribution by TEM observation〔Final-SH #1 (Weld Metal)〕



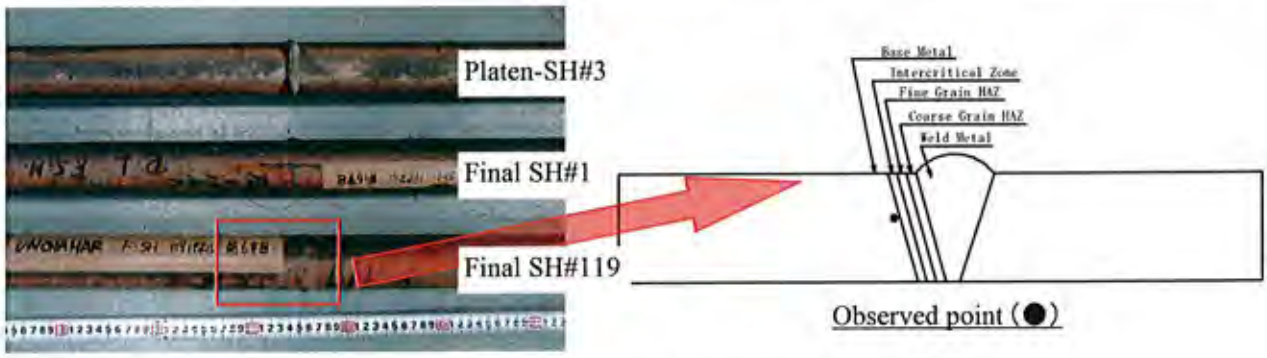


Photo II -50 Microstructure observation at cross section of sample tube
〔Final-SH #119 (Base Metal) 〕

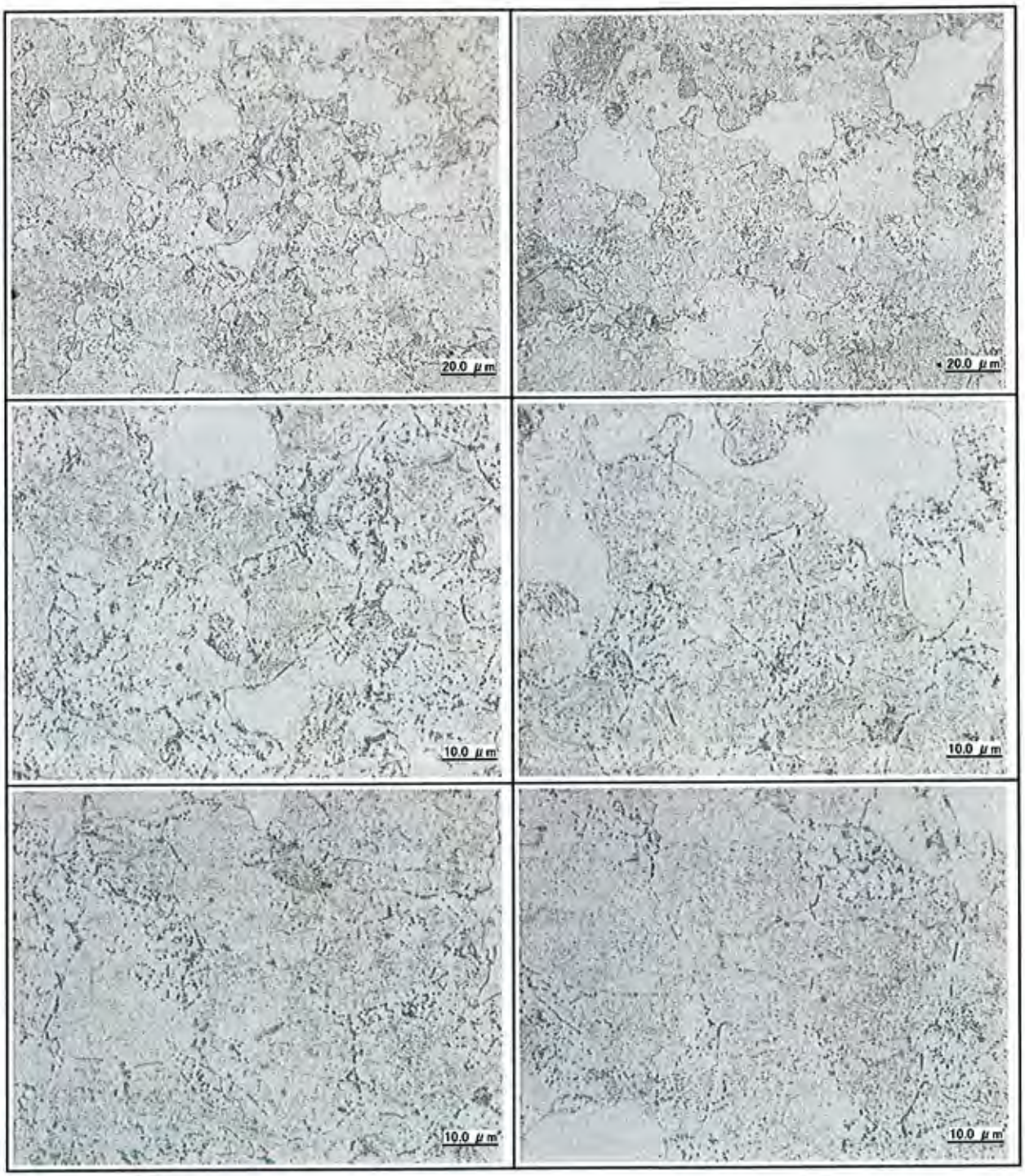
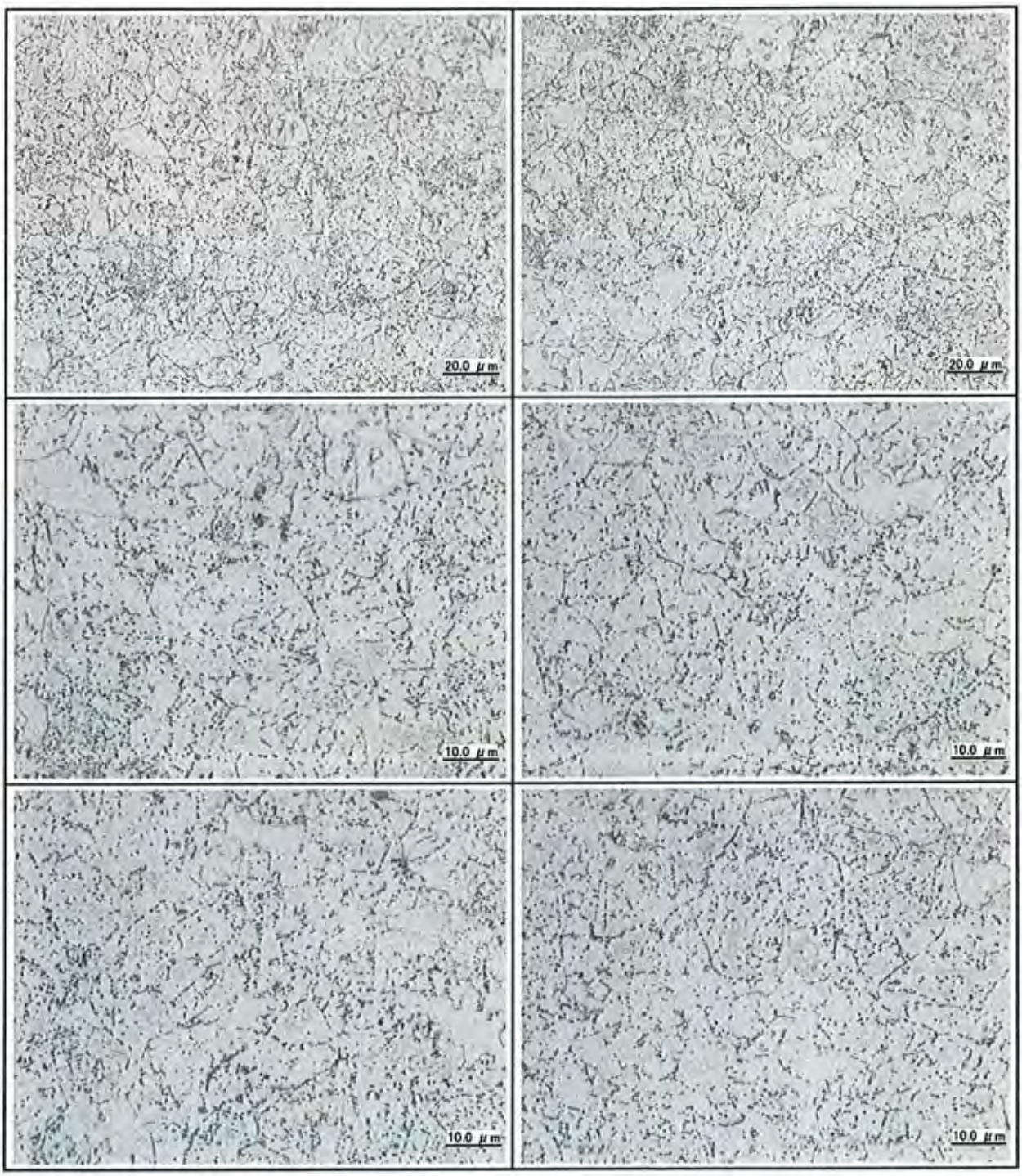


Photo II -51 Microstructure observation at cross section of sample tube
〔Final-SH #119（Intercritical Zone）〕



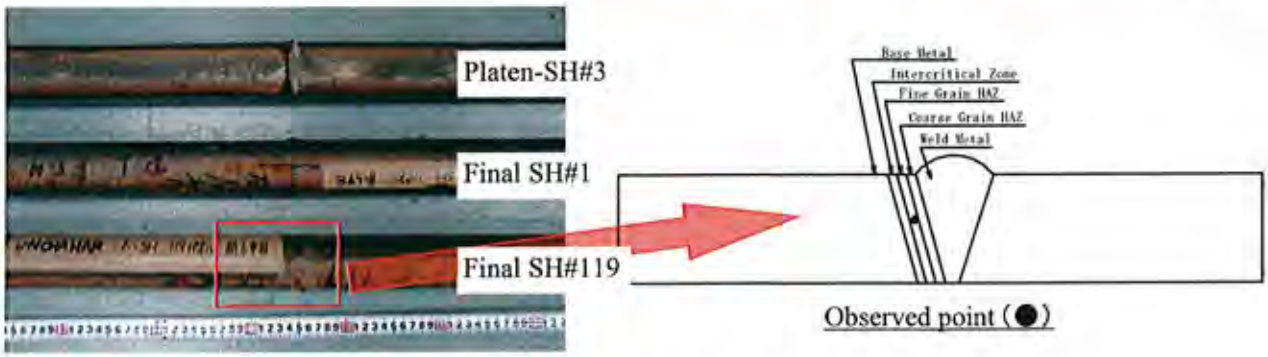
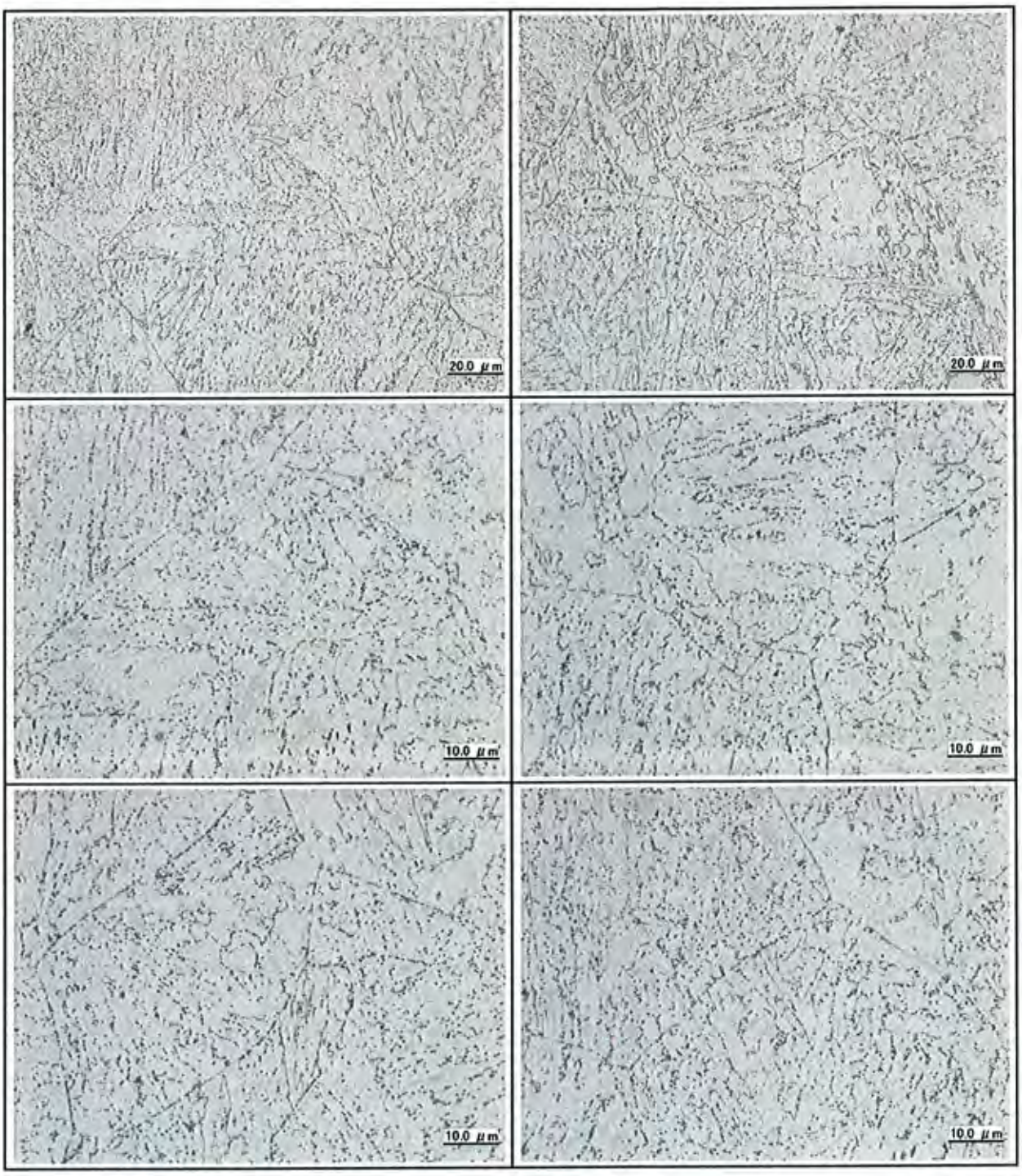


Photo II -52 Microstructure observation at cross section of sample tube
〔Final-SH #119 (Fine Grain HAZ) 〕



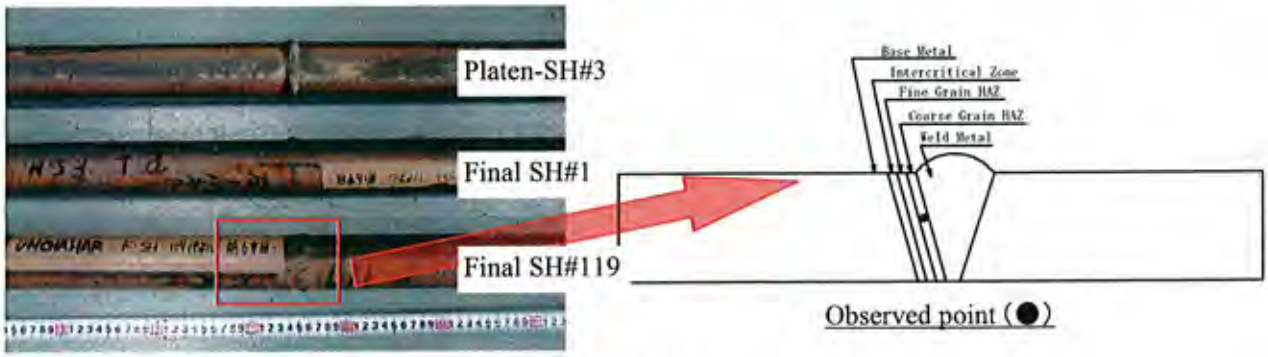
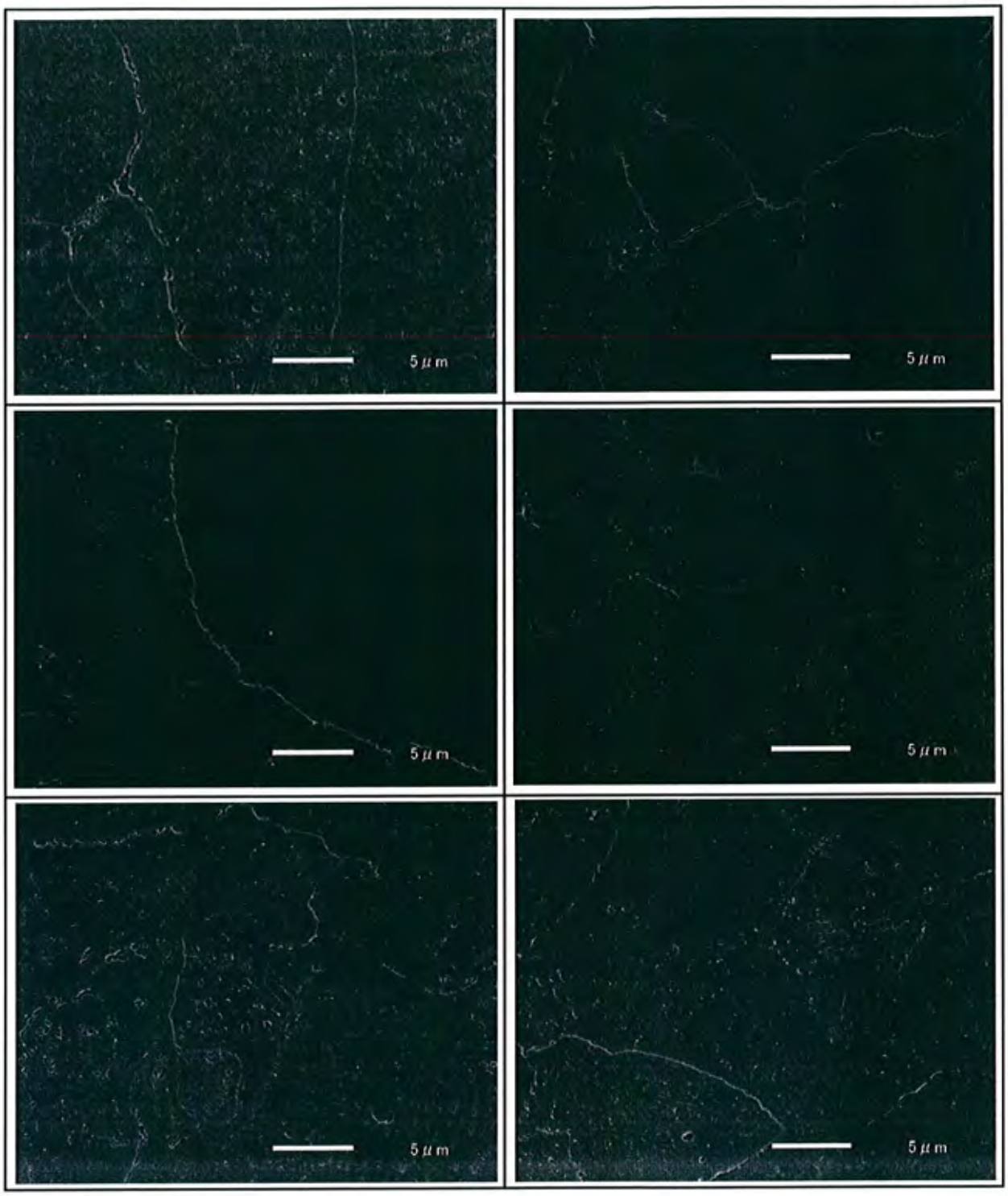


Photo Ⅱ-53 Microstructure observation at cross section of sample tube
〔Final-SH #119 (Coarse Grain HAZ) 〕

Photo II -54 Microstructure observation at cross section of sample tube
〔Final-SH #119 (Weld Metal) 〕



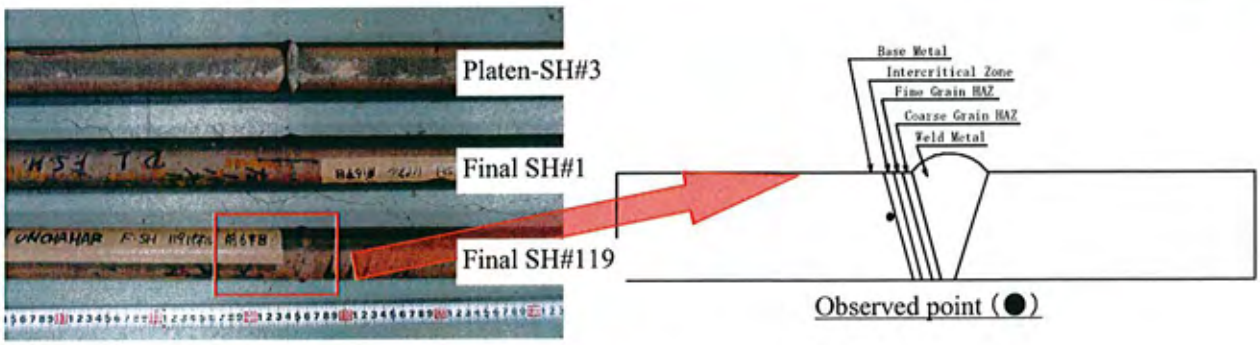
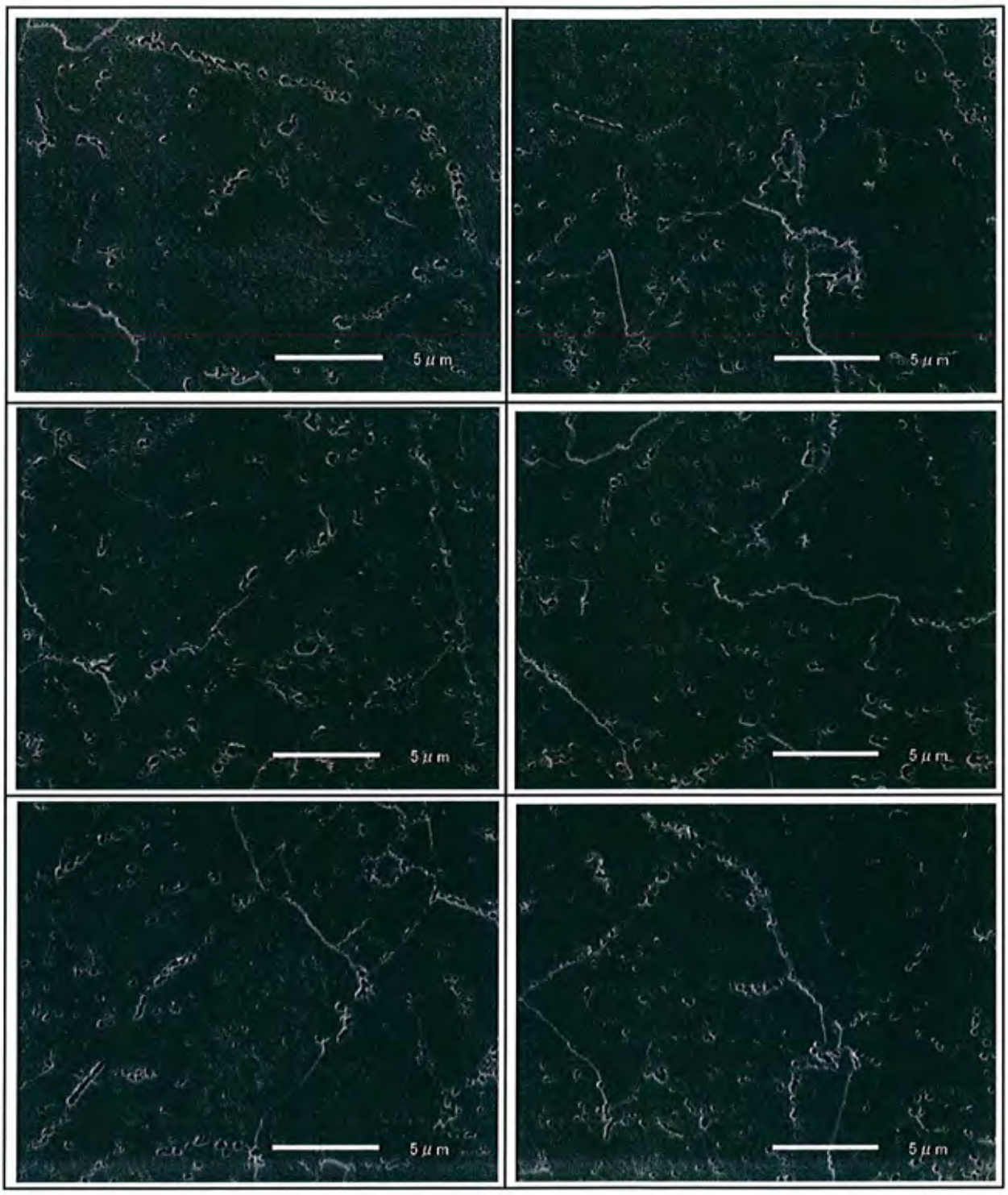


Photo II -55 Precipitates along grain boundary by SEM observation
〔Final-SH #119 (Base Metal)〕



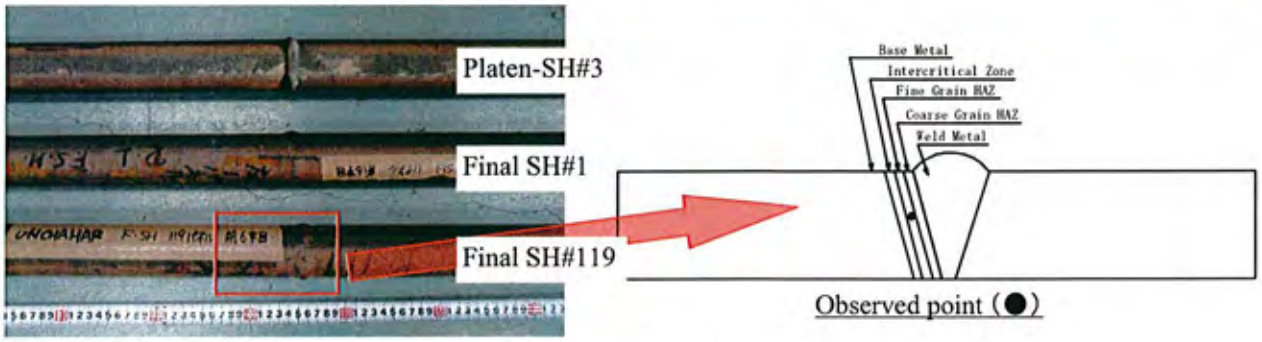
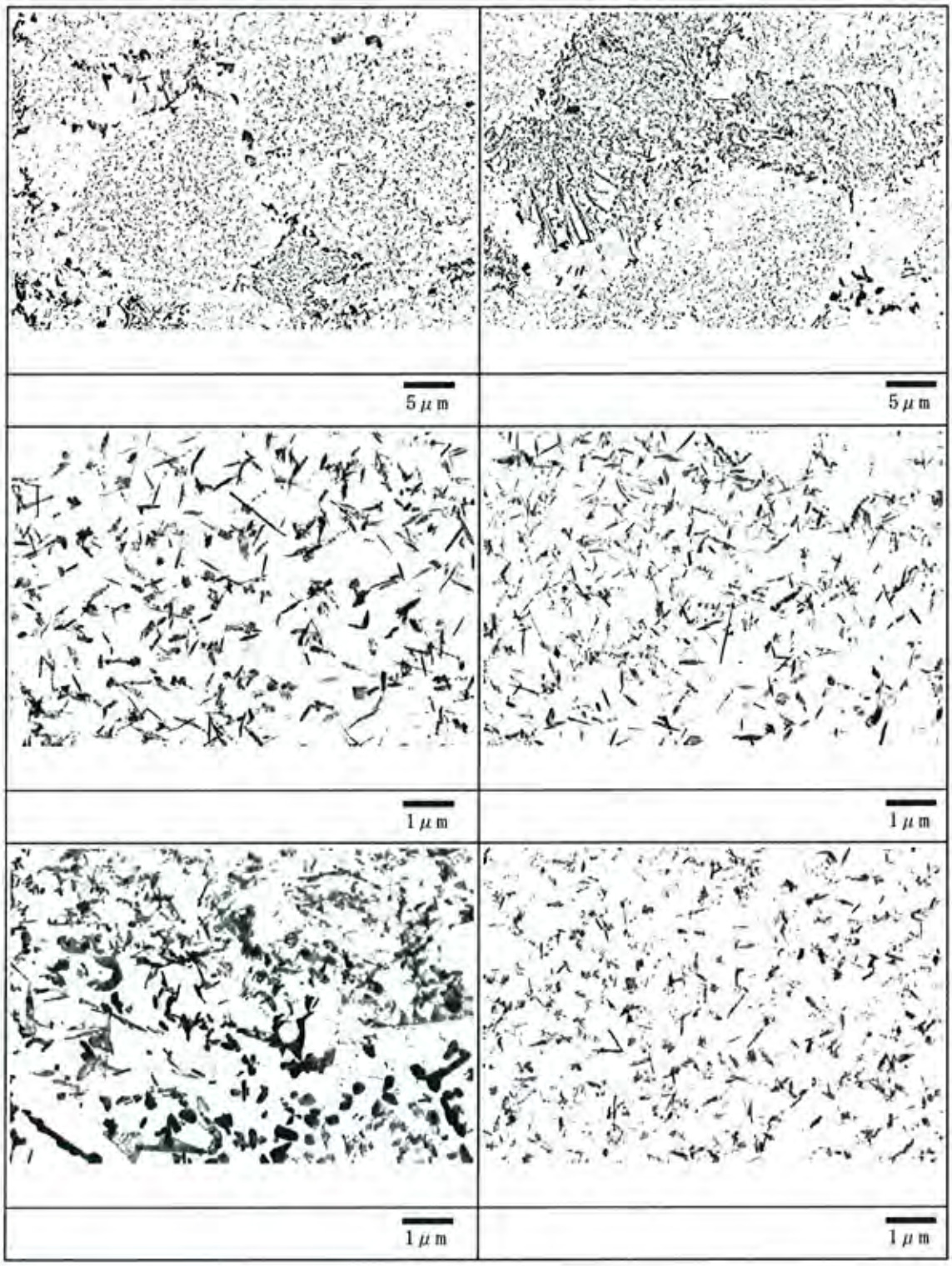


Photo II -56 Precipitates along grain boundary by SEM observatior
〔Final-SH #119 (Fine Grain HAZ) 〕



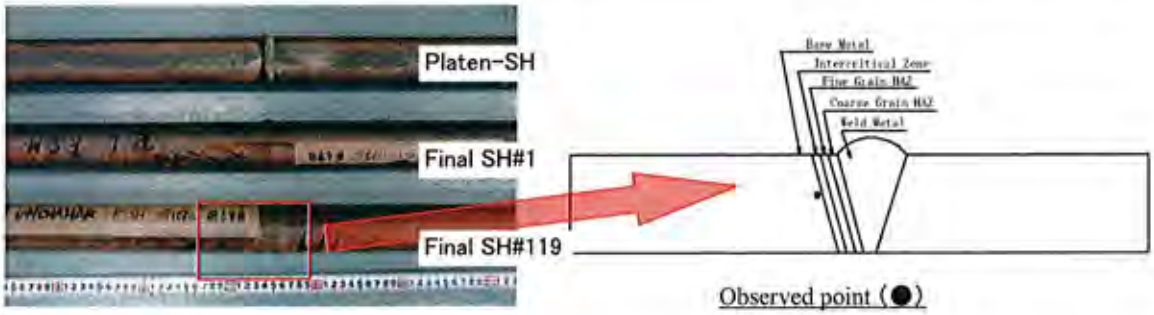
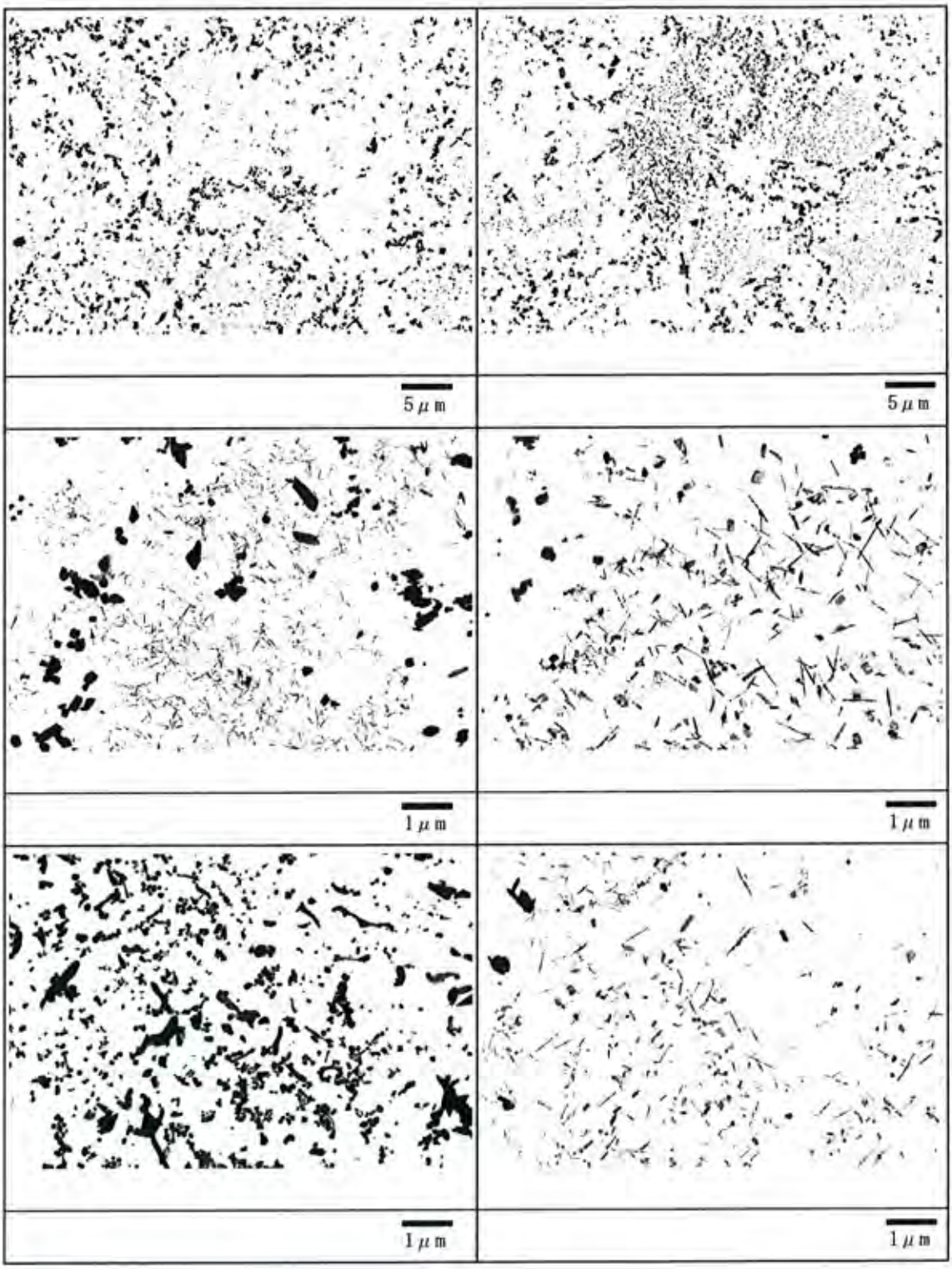
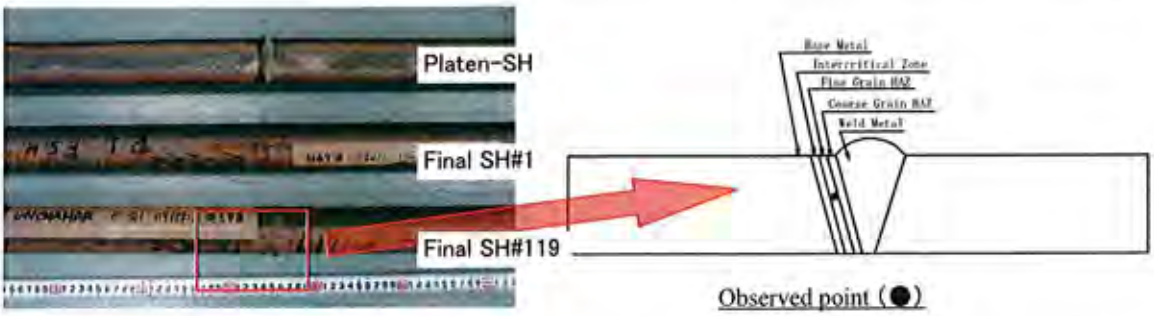


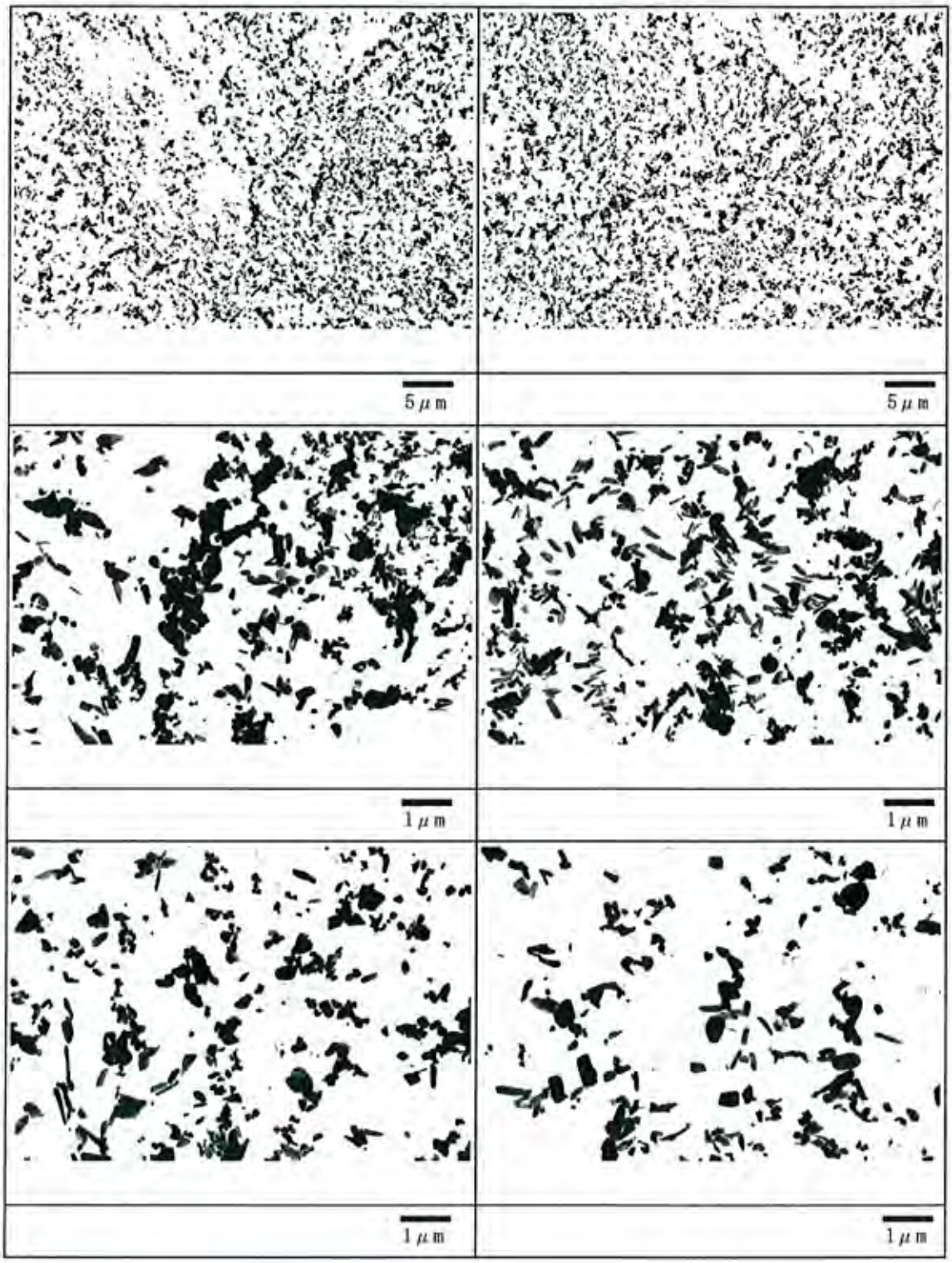
Photo II -57 Precipitates distribution by TEM observation〔Final-SH #119 (Base Metal)〕





995

Photo II -58 Precipitates distribution by TEM observation〔Final-SH #119 (Fine Grain HAZ)〕



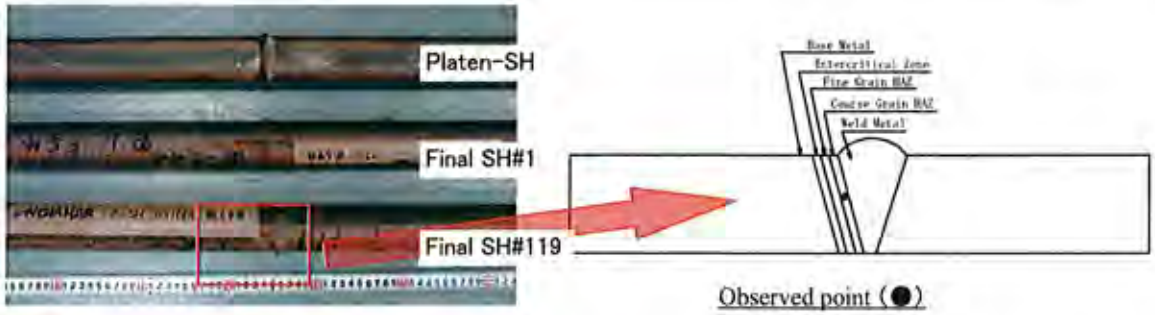
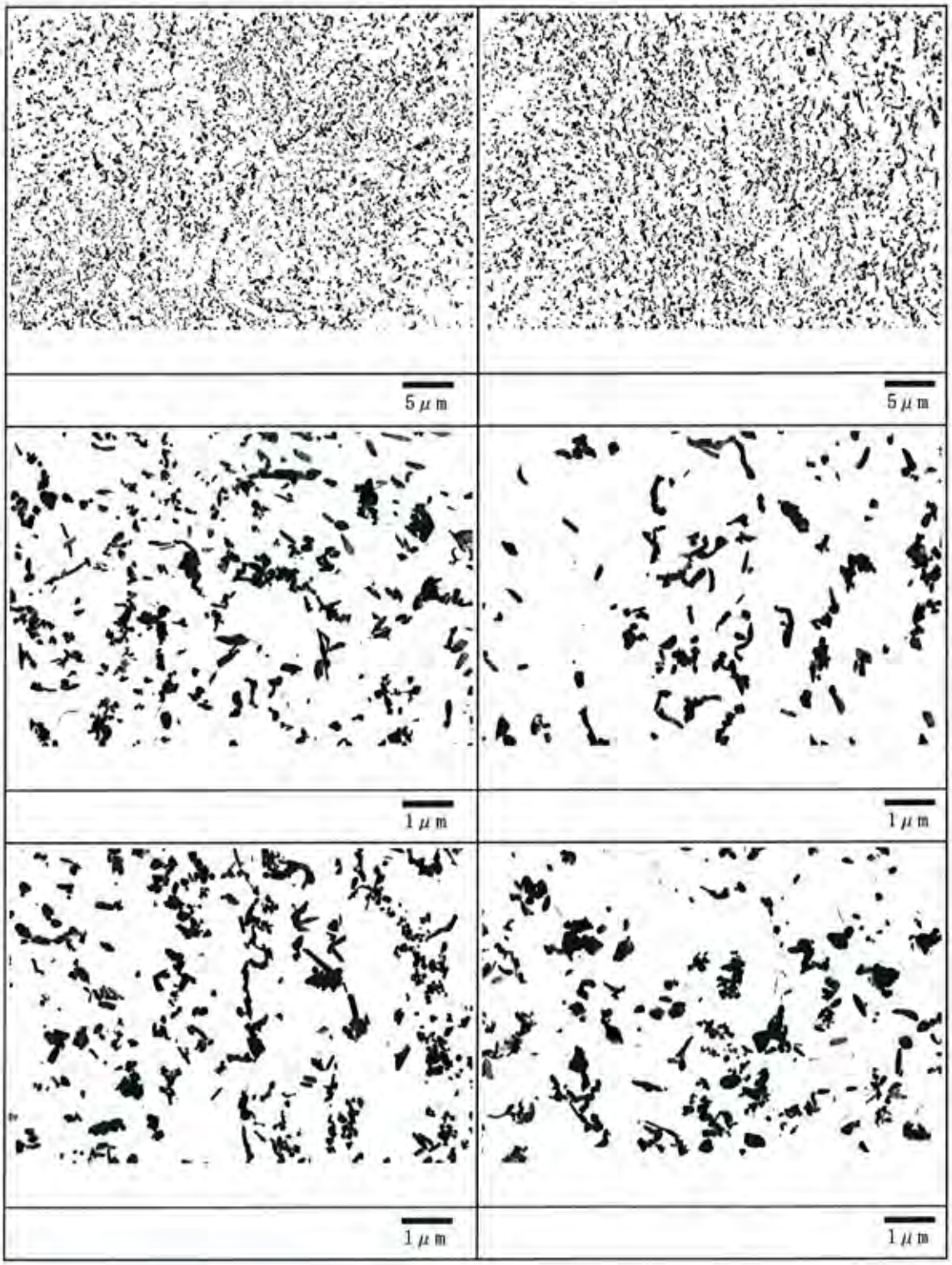


Photo II -59 Precipitates distribution by TEM observation〔Final-SH #119 (Coarse Grain HAZ) 〕



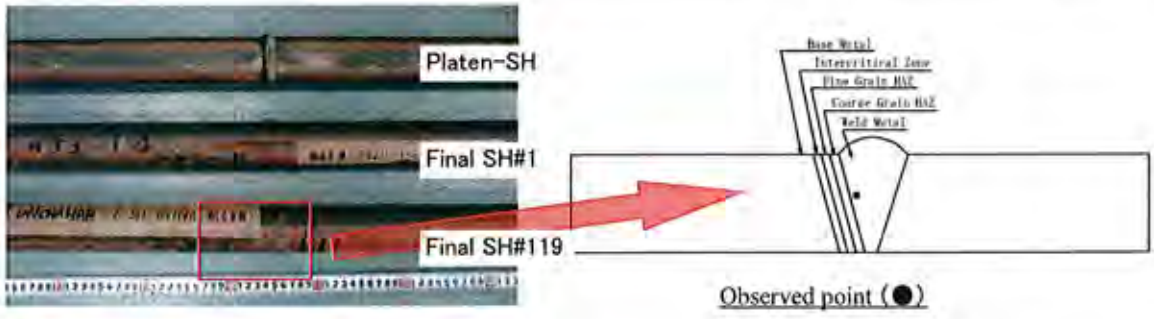
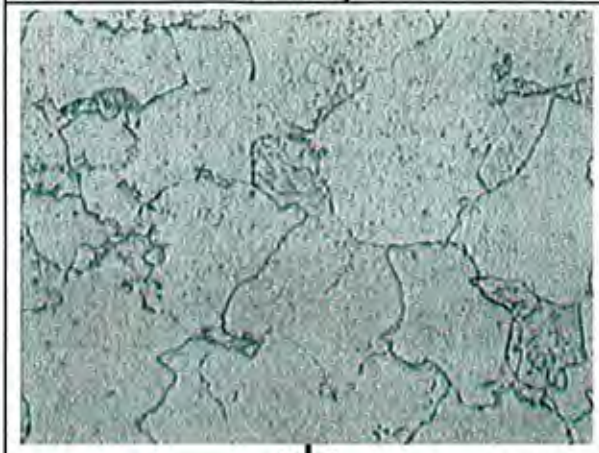
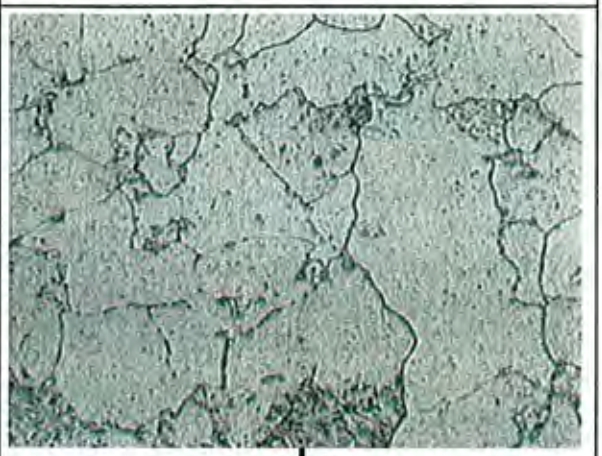
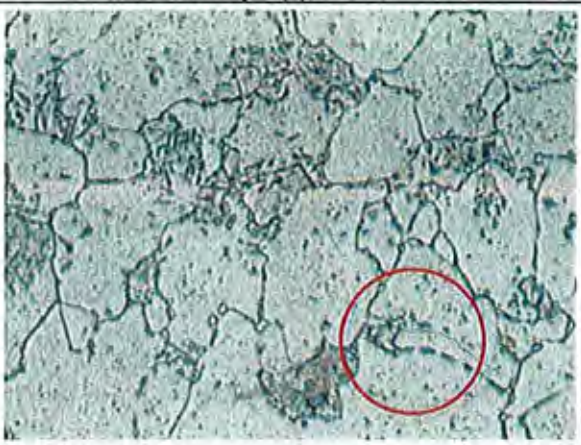
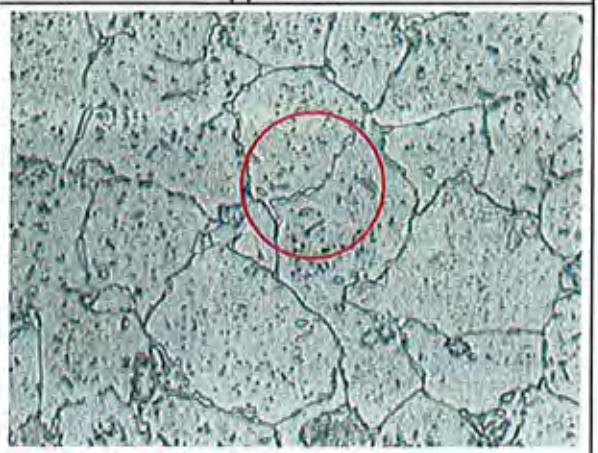


Photo II -60 Precipitates distribution by TEM observation〔Final-SH #119 (Weld Metal)〕

Reference Picture
of Microstructural Comparison Method
for Tube

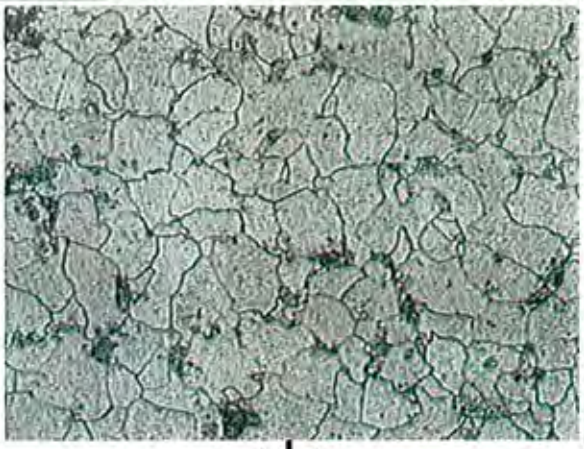
Referernce microstructure by 0ptical microscope observation
SA 213 T22 Base Metal

No precipitates free zone along grain boundary	No precipitates at grain boundary
	
×1000	×1000
Precipitates free zone along grain boundary appeared	Precipitates at gain boundary appeared
	
×1000	×1000
	Precipitation at gain boundary remarkably appeared
	
	×1000

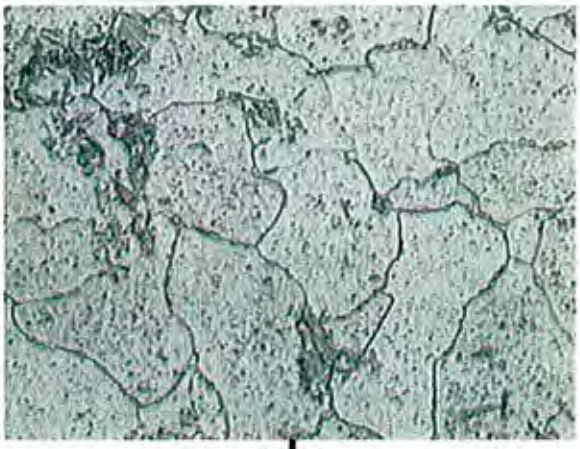
570

Referernce microstructure by 0ptical microscope observation
SA 213 T22 Base Metal

Pearlite structure



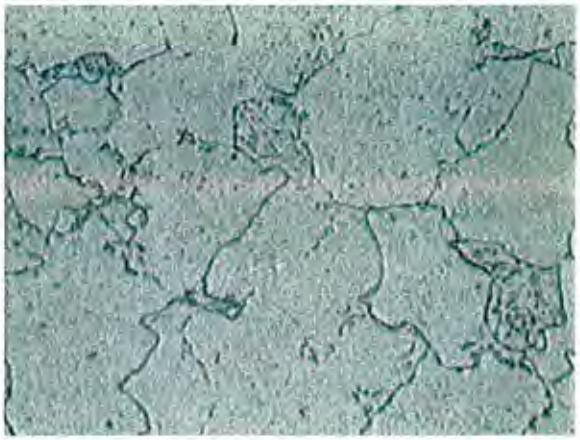
×400



×1000

Disintegration of pearlite structure

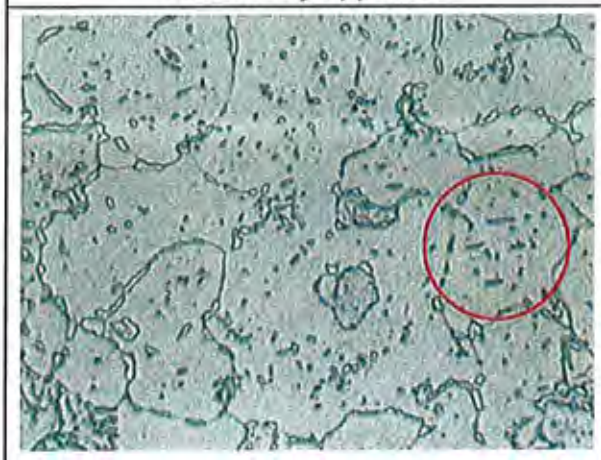
×400



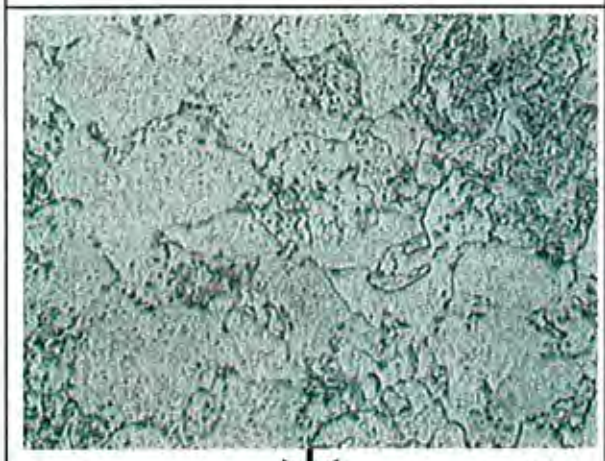
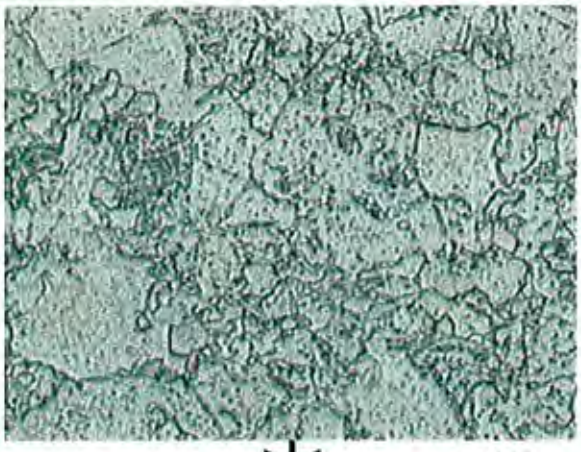
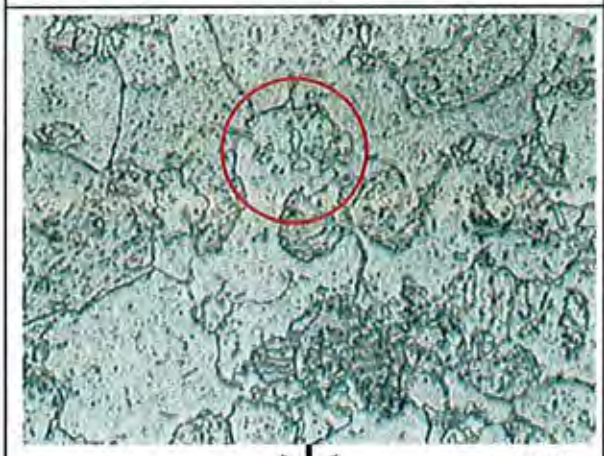
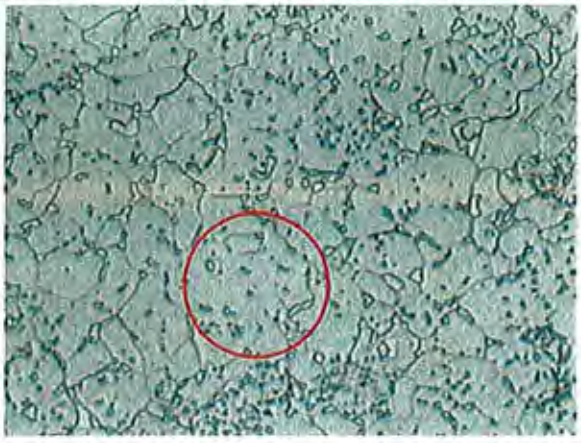
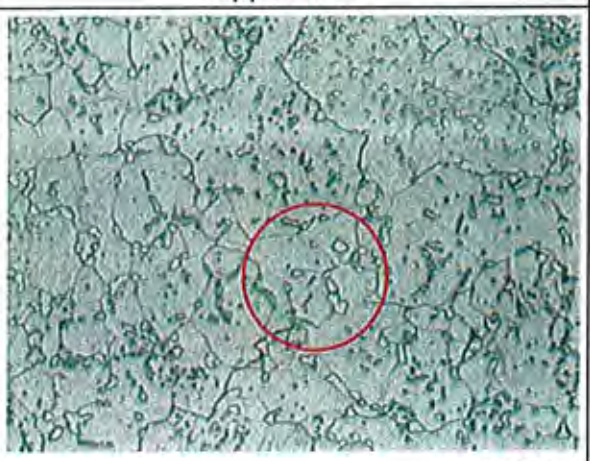
×1000

145

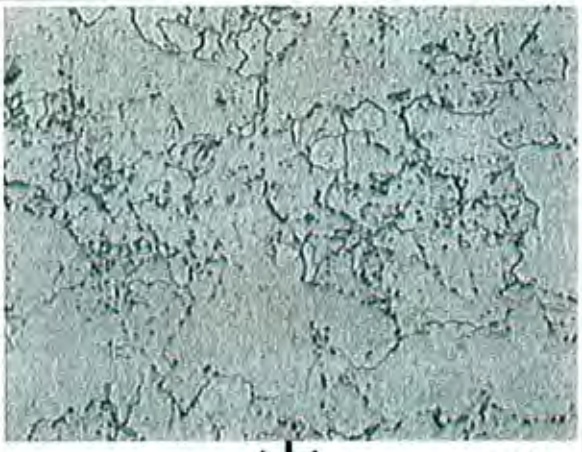
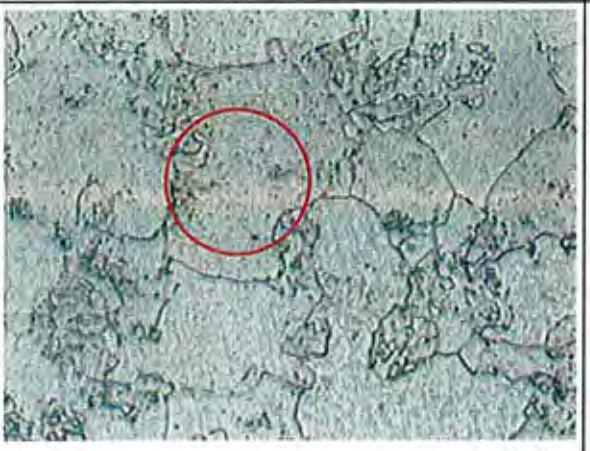
Referernce microstructure by 0ptical microscope observation
SA 213 T22 Base Metal

No rod-shaped precipitates in grain	No granular precipitates in grain
 ×1000	 ×1000
Rod-shaped precipitates in grain appeared	Granular precipitates in grain appeared
 ×1000	 ×1000
Rod-shaped precipitates in grain remarkably appeared	
 ×1000	

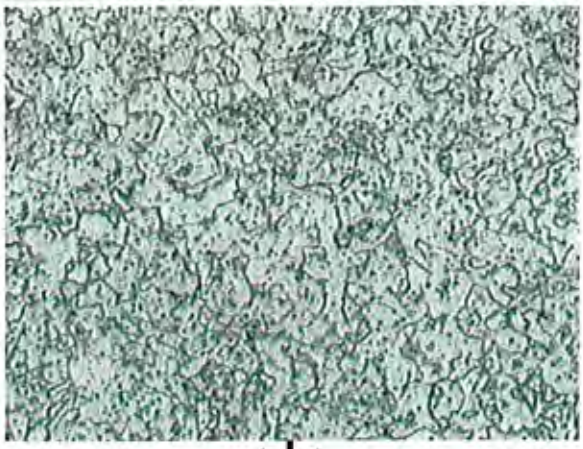
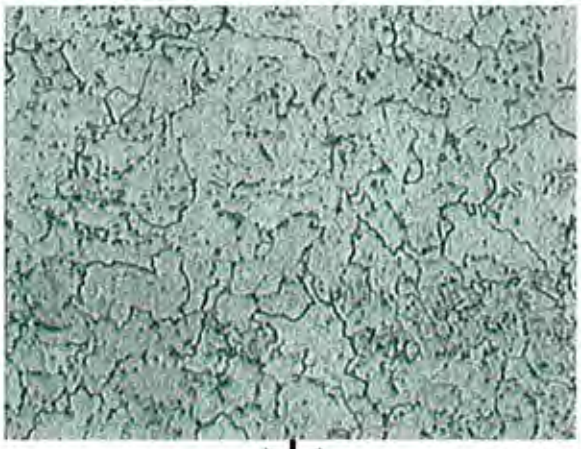
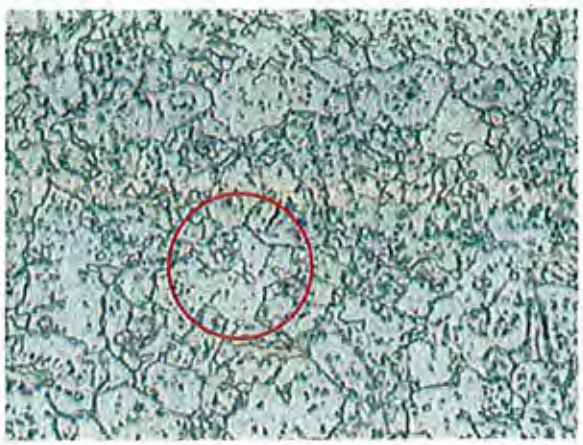
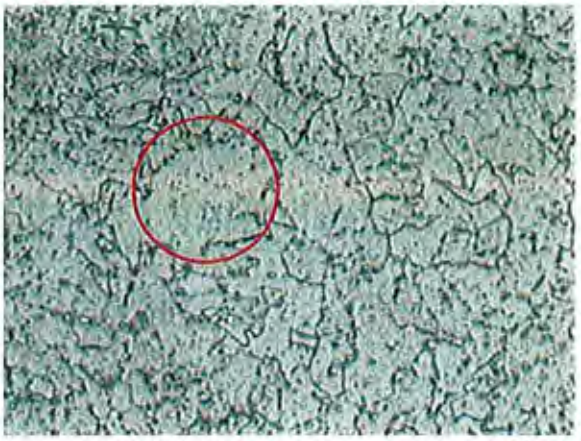
Referernce microstructure by 0ptical microscope observation
SA 213 T22 Intercritical zone (for reference)

No precipitates at grain boundary	No rod-shaped precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Rod-shaped precipitates in grain appeared
 ×1000	 ×1000
Precipitation at gain boundary remarkably appeared	
 ×1000	

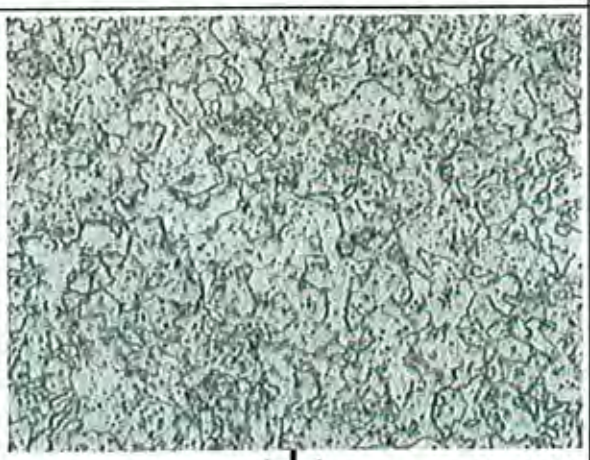
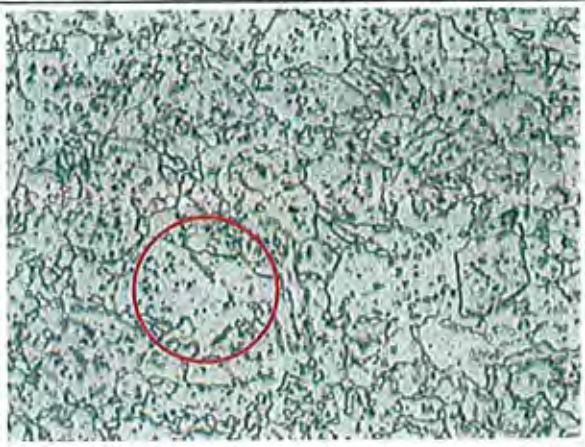
Referernce microstructure by 0ptical microscope observation
SA 213 T22　Intercritical zone (for reference)

No granular precipitates in grain	
 ×1000	
Granular precipitates in grain appeared	
 ×1000	

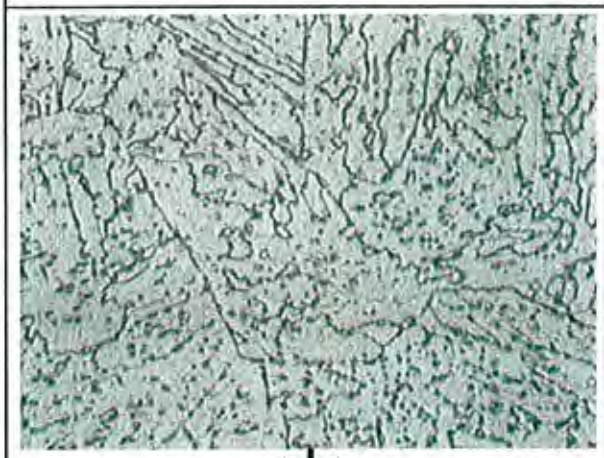
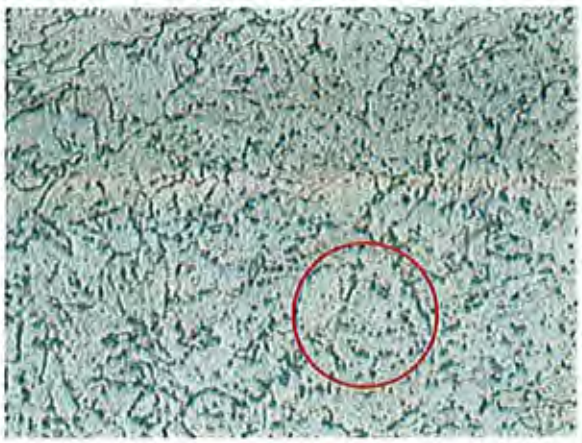
Referernce microstructure by 0ptical microscope observation
SA 213 T22 Fine grain HAZ

No precipitates at grain boundary	No granular precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Granular precipitates in grain appeared
 ×1000	 ×1000

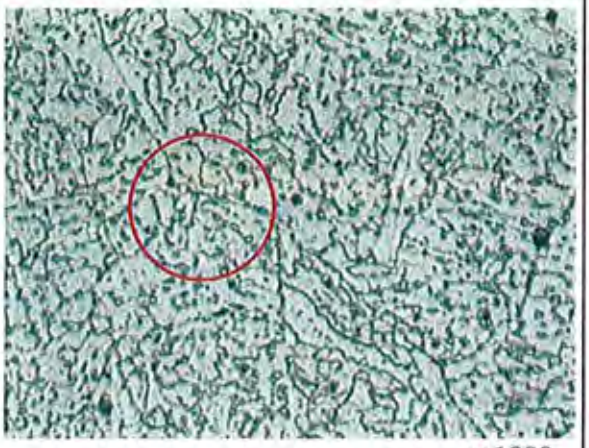
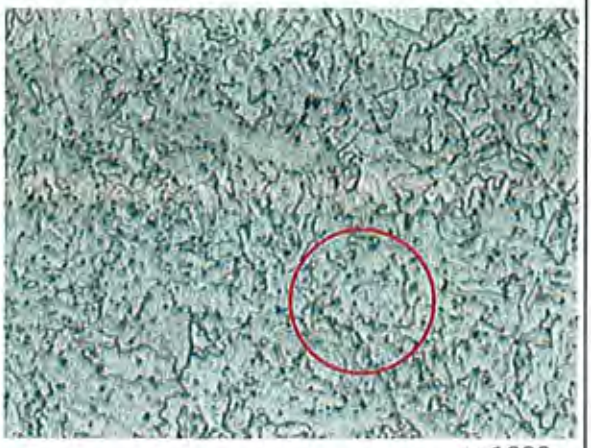
Referernce microstructure by 0ptical microscope observation
SA 213 T22　Fine grain HAZ

No rod-shaped precipitates in grain	
 ×1000	
Rod-shaped precipitates in grain appeared	
 ×1000	

Referernce microstructure by 0ptical microscope observation
SA 213 T22 Coarse grain HAZ

No precipitates at grain boundary	No granular precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Granular precipitates in grain appeared
 ×1000	 ×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T22 Weld metal

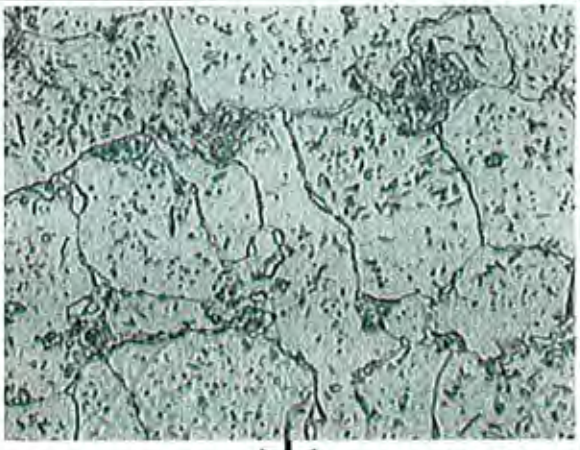
No precipitates at grain boundary	No granular precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Granular precipitates in grain appeared
 ×1000	 ×1000

845

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Base Metal

Pearlite structure

×400



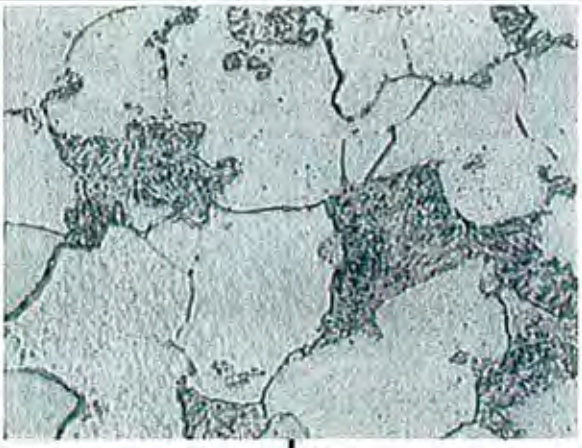
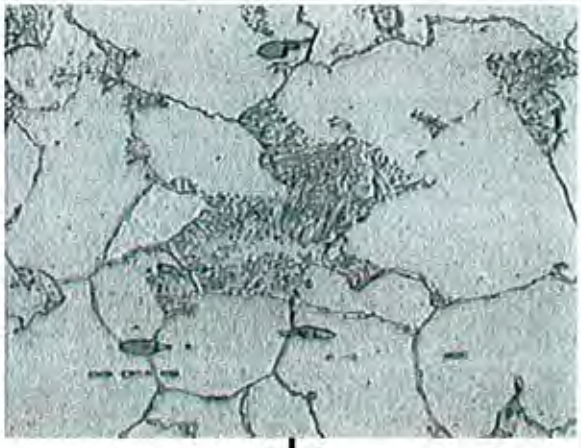
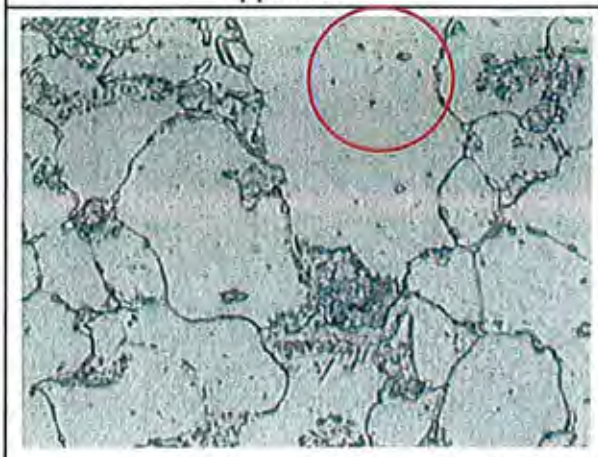
×1000

Disintegration of pearlite structure

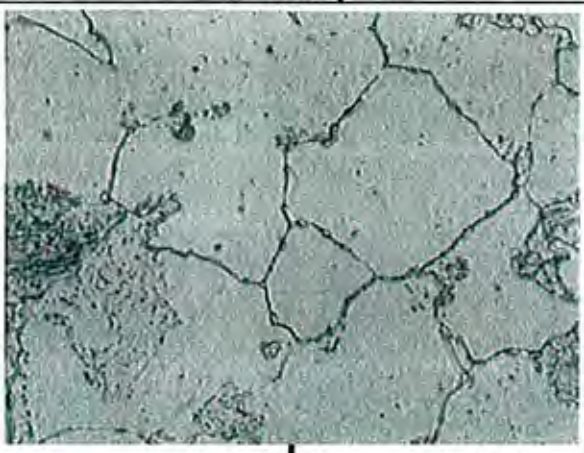
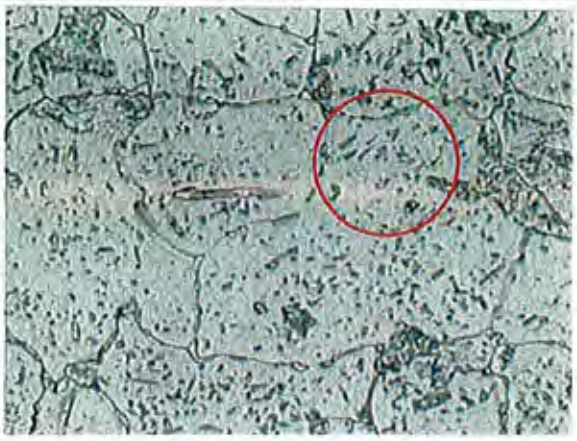
×400

×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Base Metal

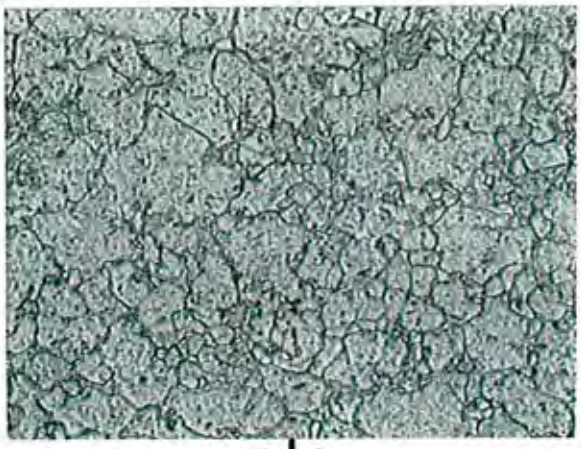
No granular precipitates in grain	No precipitates at grain boundary
	
×1000	×1000
Granular precipitates in grain appeared	Precipitates at gain boundary remarkably appeared
	
×1000	×1000
	Precipitation at gain boundary remarkably appeared
	
	×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Base Metal

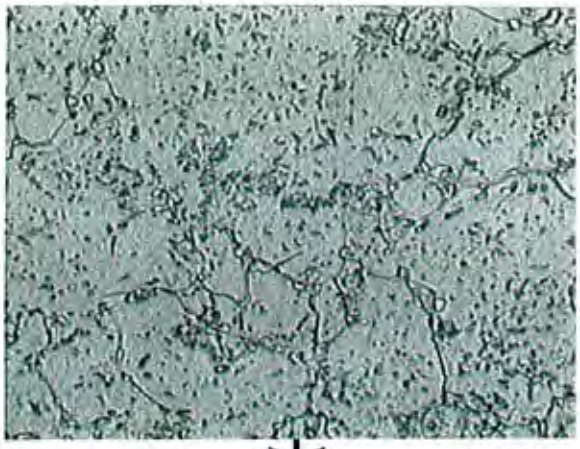
No precipitates free zone along grain boundary	No rod-shaped precipitates in grain
 ×1000	 ×1000
Precipitates free zone along grain boundary appeared	Rod-shaped precipitates in grain appeared
 ×1000	 ×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Intercritical zone (for reference)

Normal subgrain boundary

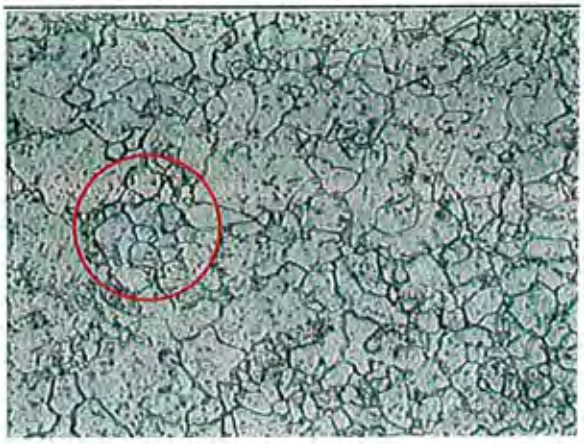


×400

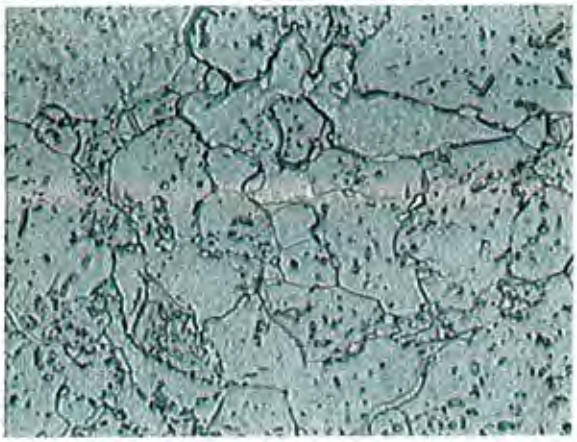


×1000

Subgrain boundary clearly appeared



×400



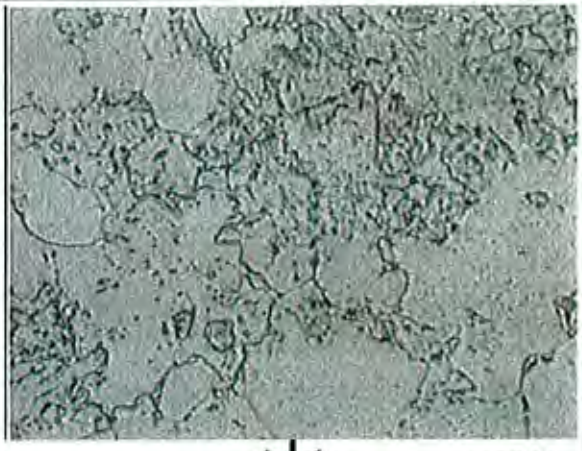
×1000

582

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Intercritical zone (for reference)

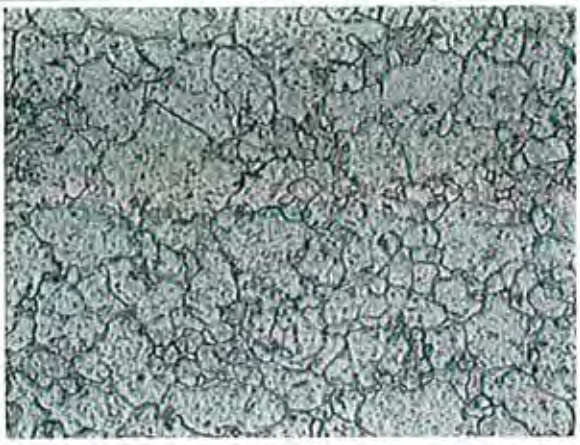
Pearlite structure

×400

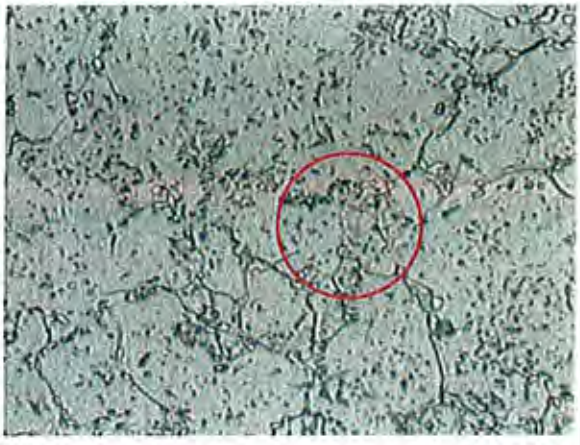


×1000

Disintegration of pearlite structure

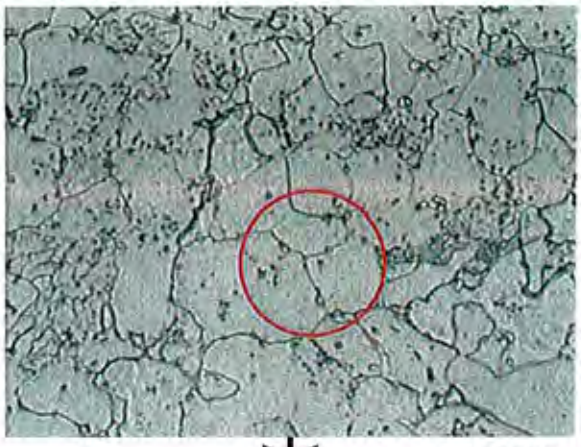
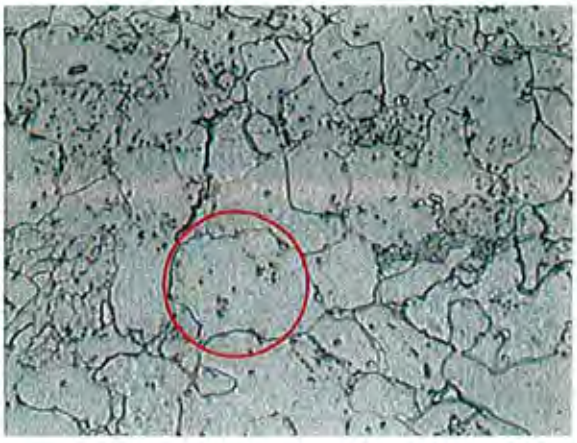
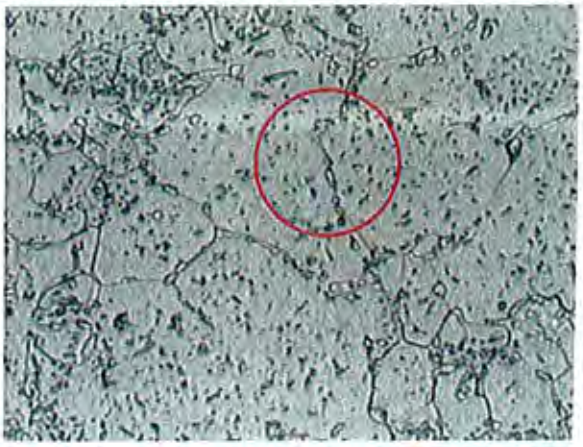


×400



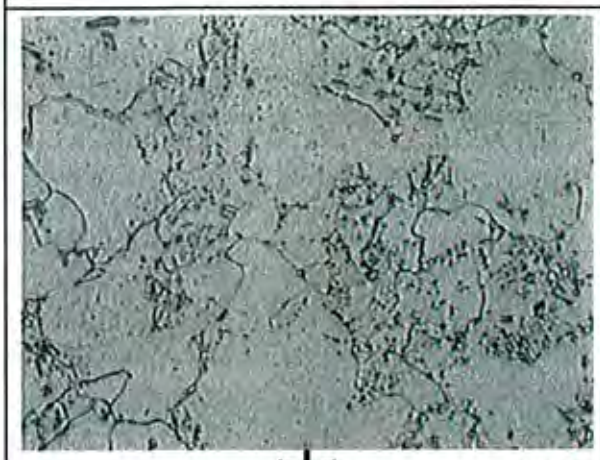
×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Intercritical zone (for reference)

No precipitates at grain boundary	No granular precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Granular precipitates in grain appeared
 ×1000	 ×1000
Precipitation at gain boundary remarkably appeared	
 ×1000	

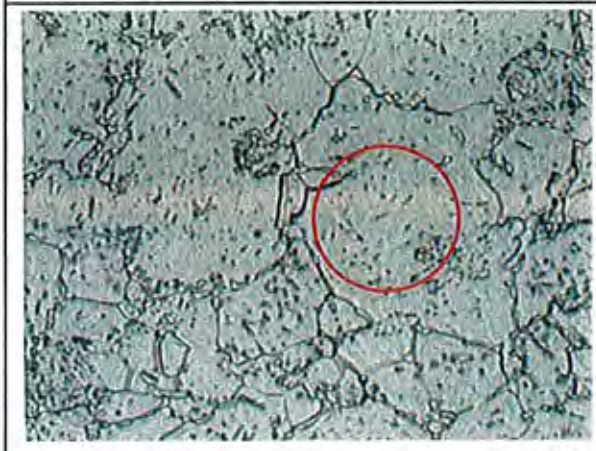
Referernce microstructure by 0ptical microscope observation
SA 213 T11　Intercritical zone (for reference)

No rod-shaped precipitates in grain



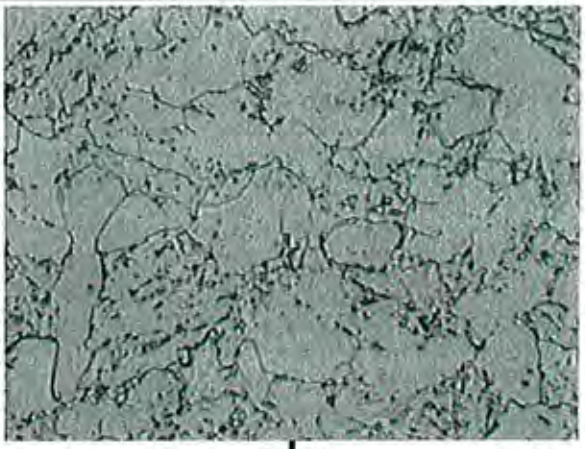
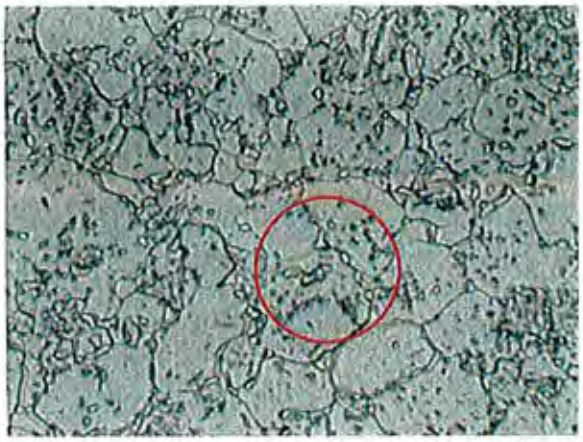
×1000

Rod-shaped precipitates in grain appeared



×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Fine grain HAZ

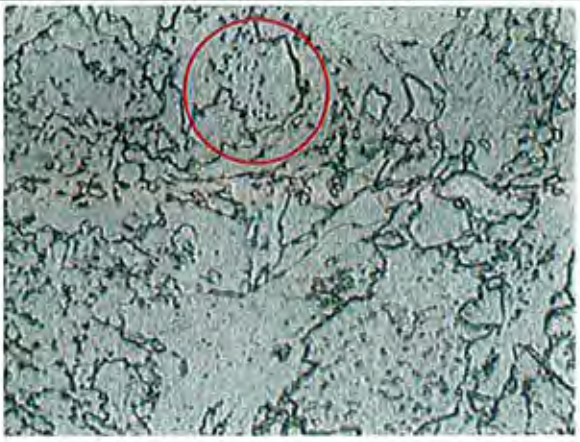
No precipitates at grain boundary	No spotlike precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Spotlike in grain appeared
 ×1000	 ×1000

995

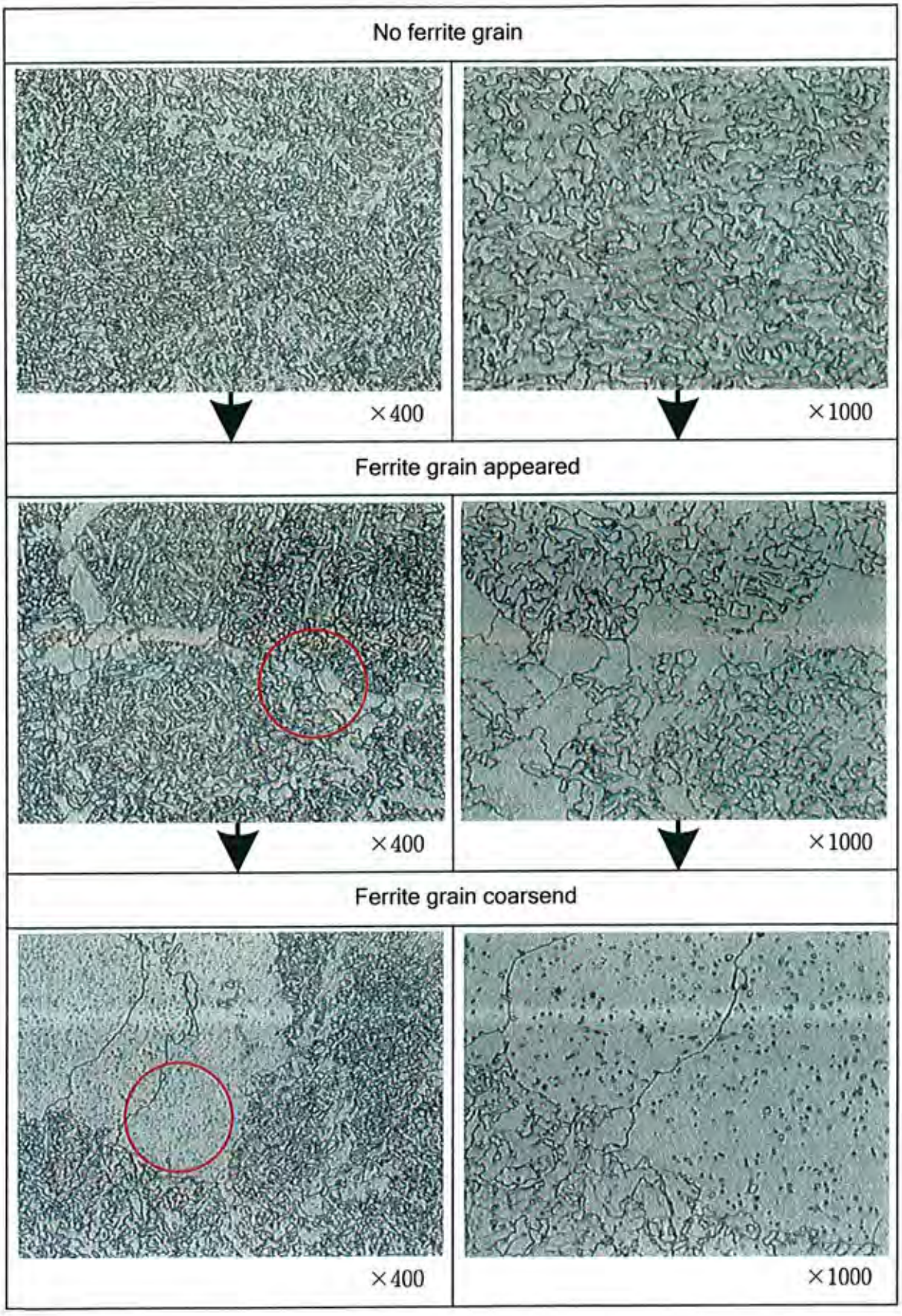
Referernce microstructure by 0ptical microscope observation
SA 213 T11　Fine grain HAZ

No small rod-shaped precipitates in grain	
 ×1000	
Small rod-shaped precipitates in grain appeared	
 ×1000	

Referernce microstructure by 0ptical microscope observation
SA 213 T11　Coarse grain HAZ

No precipitates at grain boundary	No granular precipitates in grain
 ×1000	 ×1000
Precipitates at gain boundary appeared	Granular precipitates in grain appeared
 ×1000	 ×1000

Referernce microstructure by 0ptical microscope observation
SA 213 T11 Weld metal

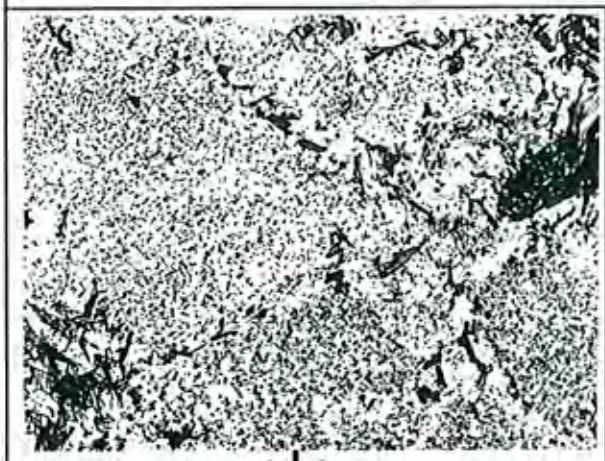


Referernce microstructure by 0ptical microscope observation
SA 213 T11 Weld metal

No granular precipitates in ferrite grain	No precipitates at grain boundary
 ×1000	 ×1000
No granular precipitates in ferrite grain appeared	Precipitates at gain boundary appeared
 ×1000	 ×1000

Referernce microstructure by TEM observation
SA 213 T22 Base Metal

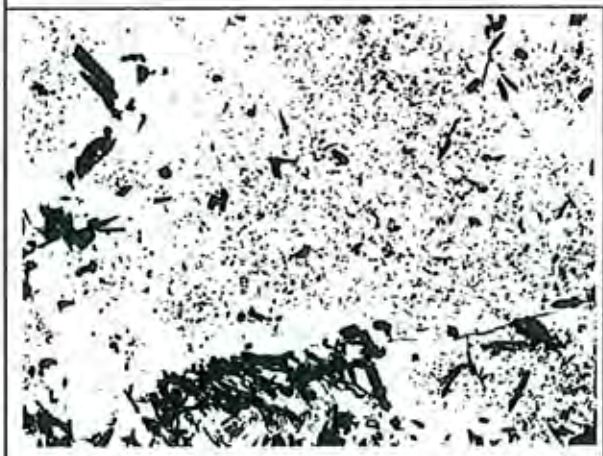
Fine granular and needlelike precipitates remaining



×2000

×10000

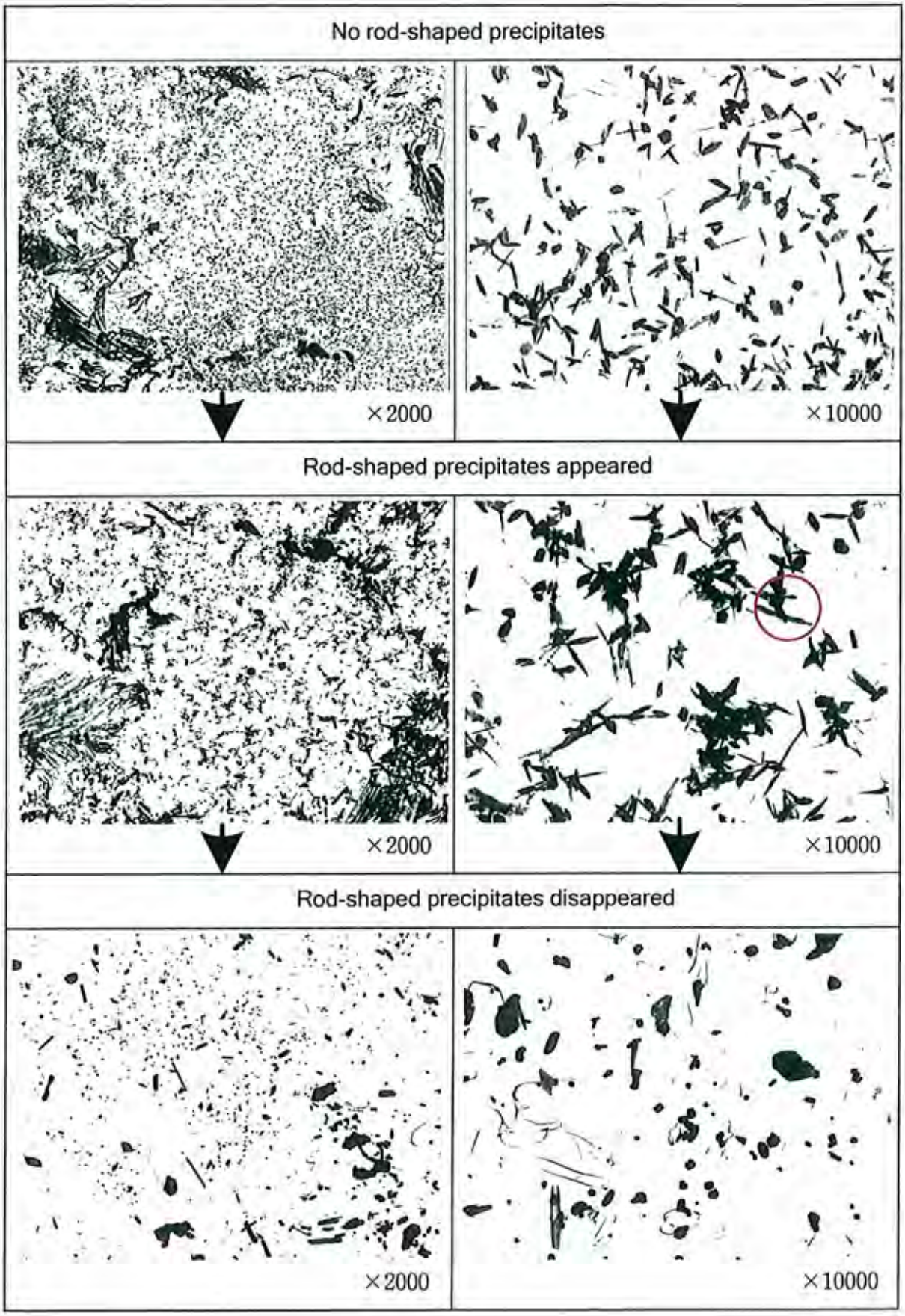
Fine granular and needlelike precipitates disappeared



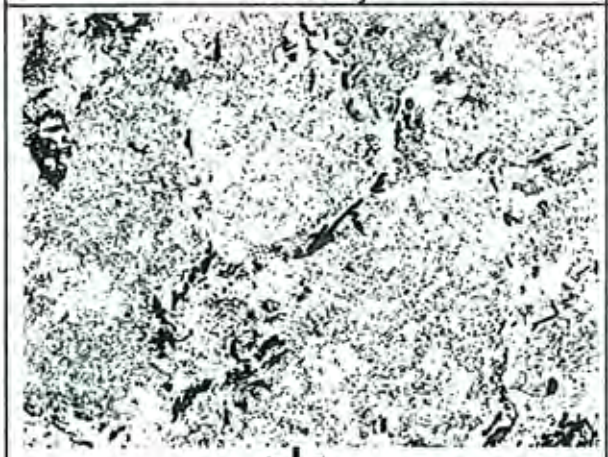
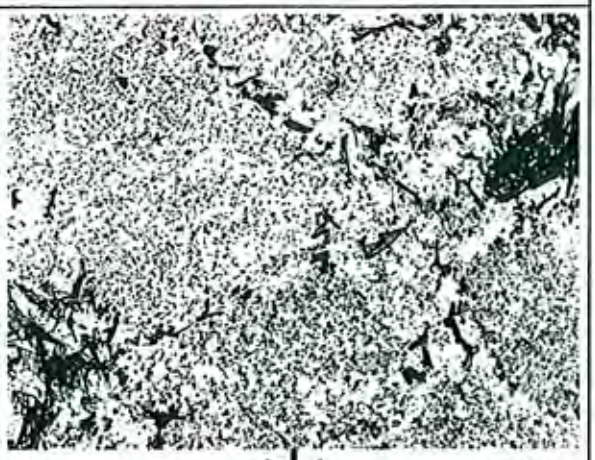
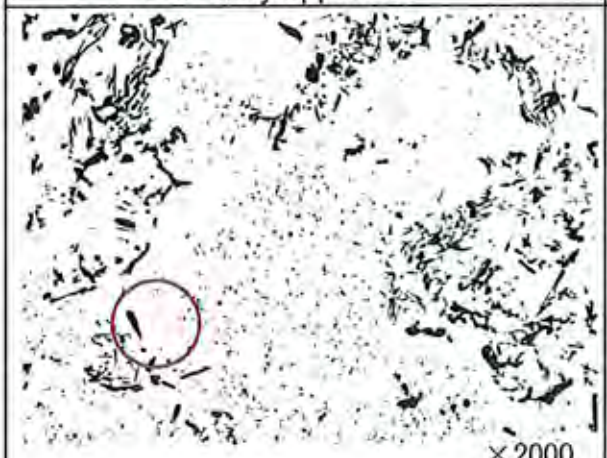
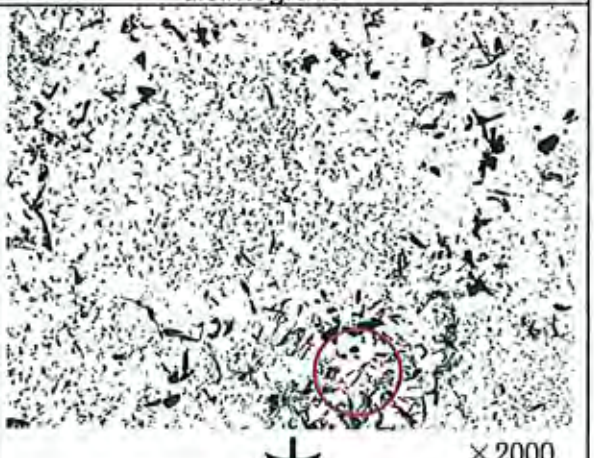
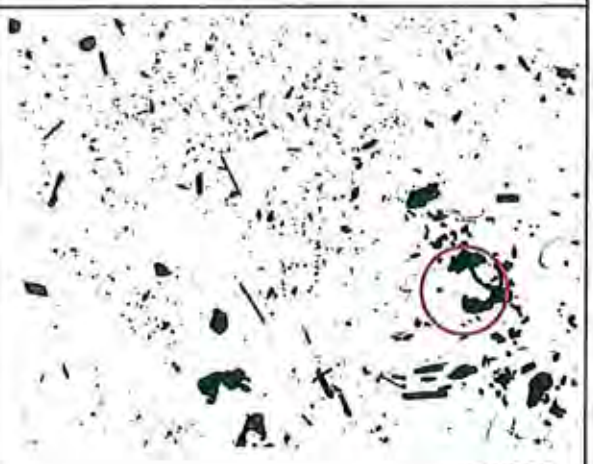
×2000

×10000

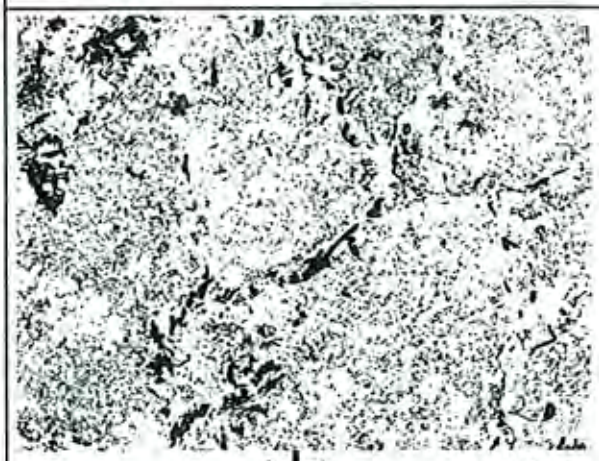
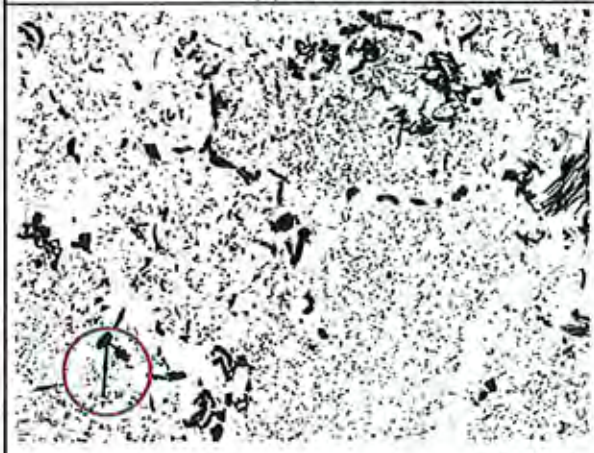
Referernce microstructure by TEM observation
SA 213 T22 Base Metal



Referernce microstructure by TEM observation
SA 213 T22 Base Metal

No precipitates free zone along grain boundary	Pearlite structure
 ×2000	 ×2000
Precipitates free zone along grain boundary appeared	Beginning of pearlite structure disintegration
 ×2000	 ×2000
	Disintegration of pearlite structure
	 ×2000

Referernce microstructure by TEM observation
SA 213 T22 Base Metal

No attenuated plate-shaped precipitates	
 ×2000	
Attenuated plate-shaped precipitates appeared	
 ×2000	