

# INFLUENCE OF MICROSTRUCTURE ON SMALL CRACK GROWTH BEHAVIOUR OF MARAGING STEEL WELD

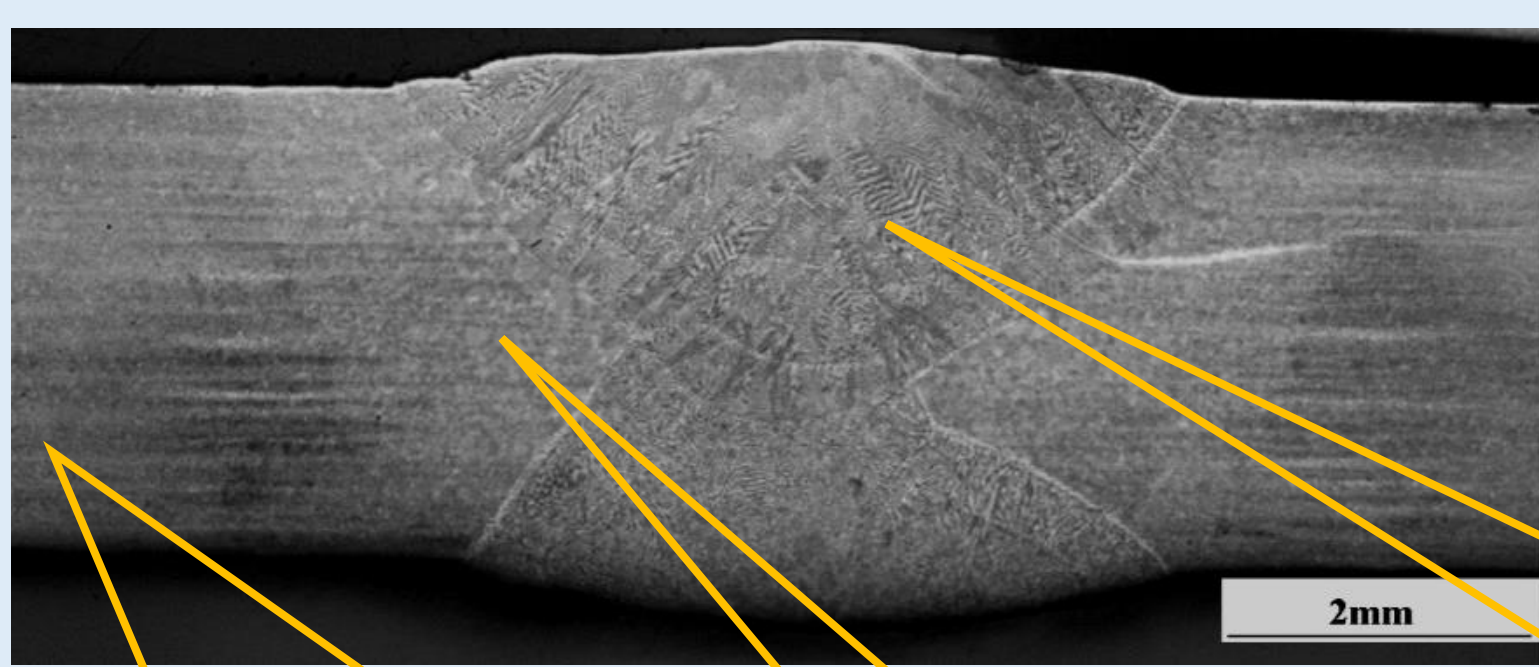
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## INTRODUCTION

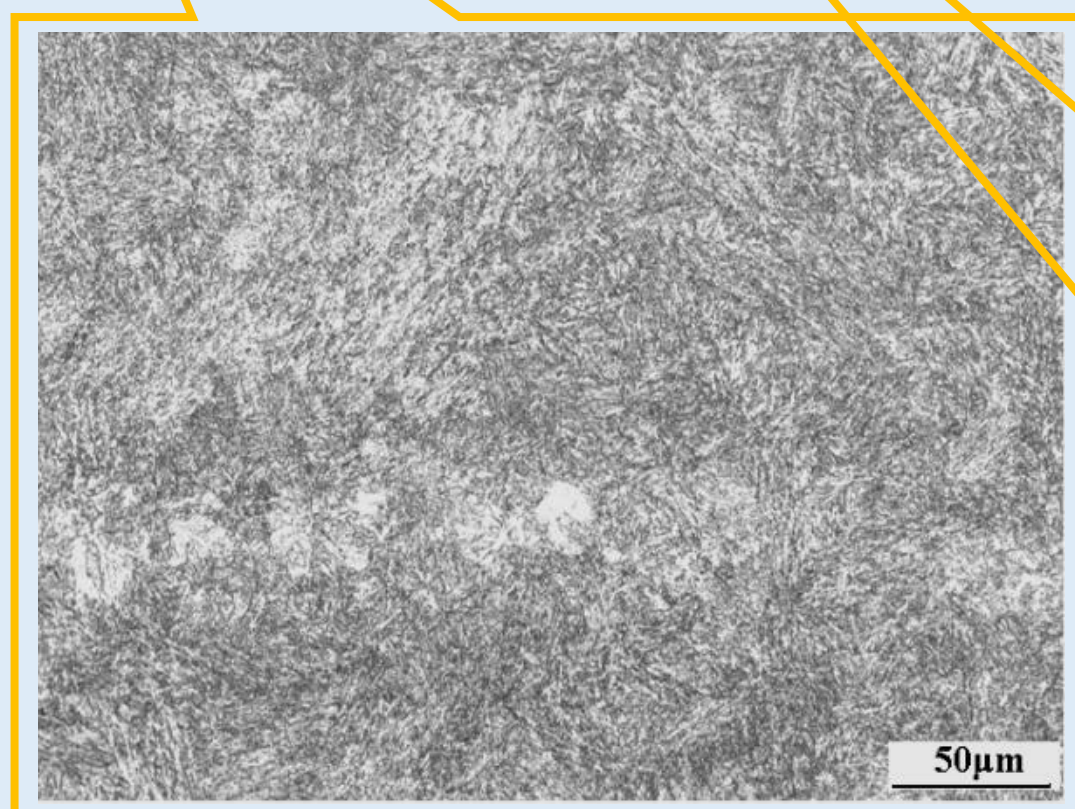
In engineering applications, micro-defects in weld metal often lead to the fatigue failure of welded structures of high-strength steel, and severe microstructure heterogeneity of weld metal also affects the fatigue crack growth behaviour. However, the researches on crack growth behaviour of weld metal of high-strength steel have been more focused on long crack growth performance, while small crack growth behaviour of weld metal has been lack of understanding. This paper takes 18Ni maraging steel as the object to analyze the effect and mechanism of microstructure characteristics of weld metal on small crack growth behaviour.

## EXPERIMENTAL RESULTS

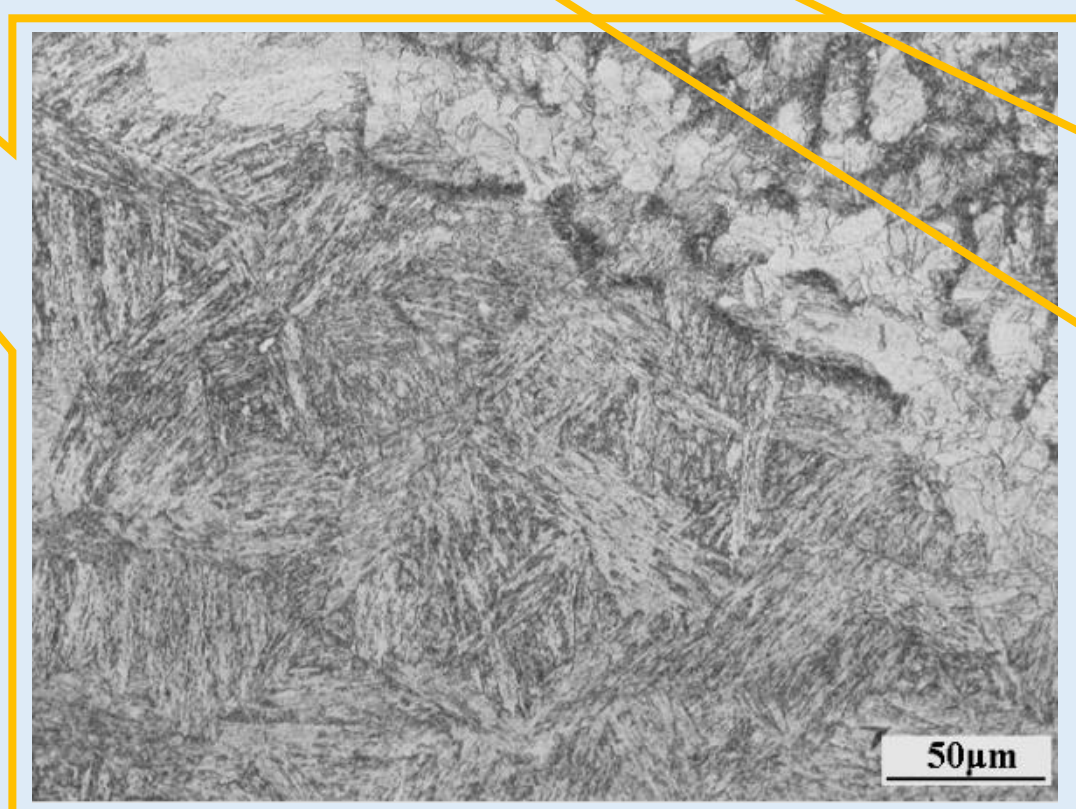


Major chemical compositions of 18Ni maraging steel (wt %)

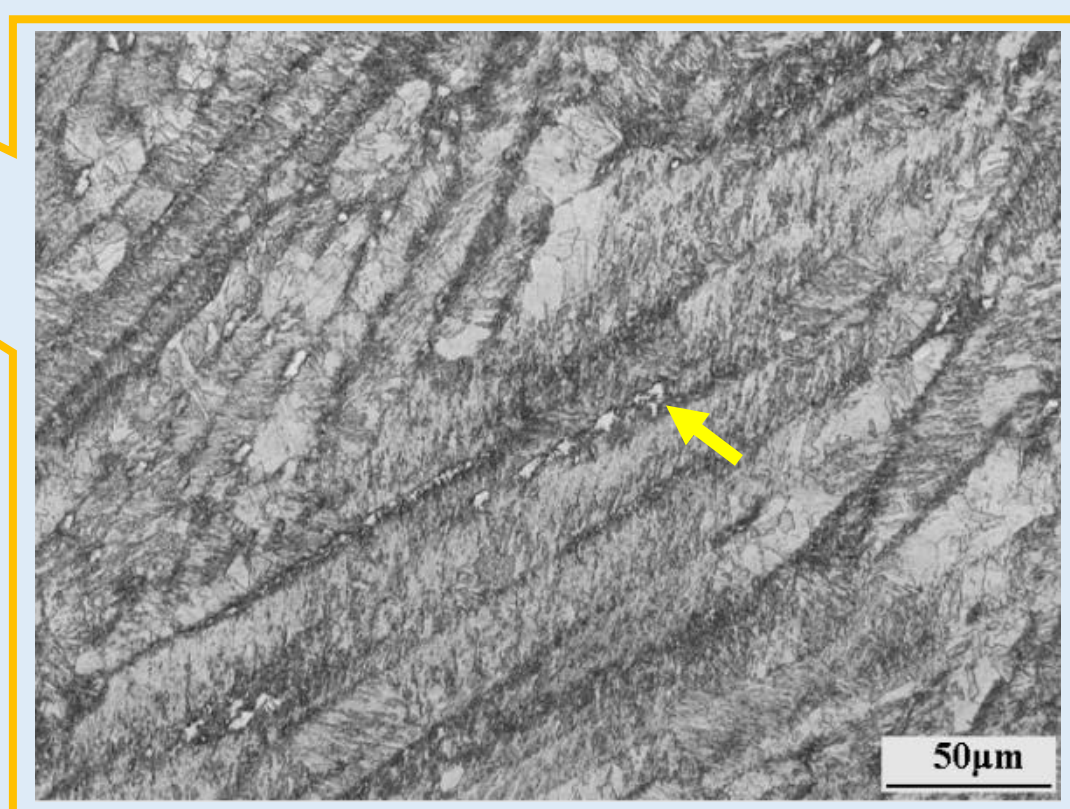
C	Ni	Mo	Co	Cr	Si	Ti	Al	Mn	S	Cu	Fe
≤0.02	17.50~ 19.00	4.60~ 5.20	7.50~ 8.50	≤0.5	≤0.10	0.30~ 0.50	0.05~ 0.15	≤0.10	≤0.007	≤0.5	matrix



Base metal

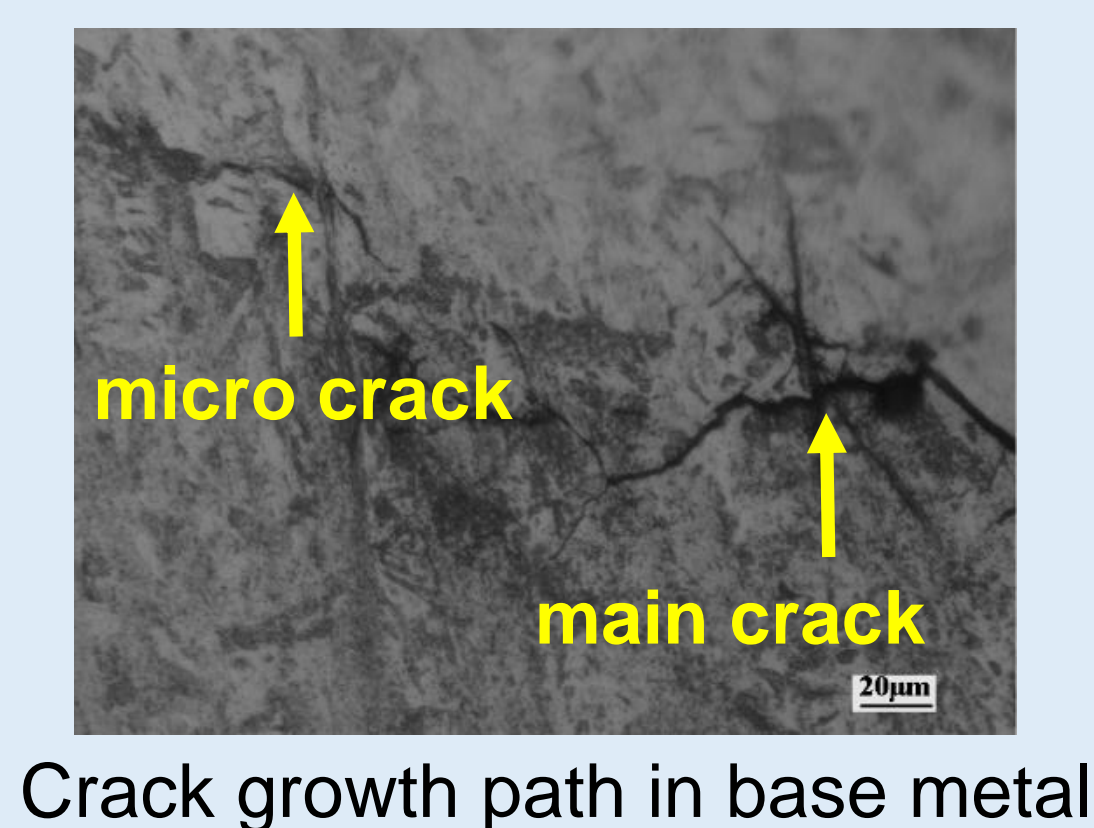


Heat affected zone

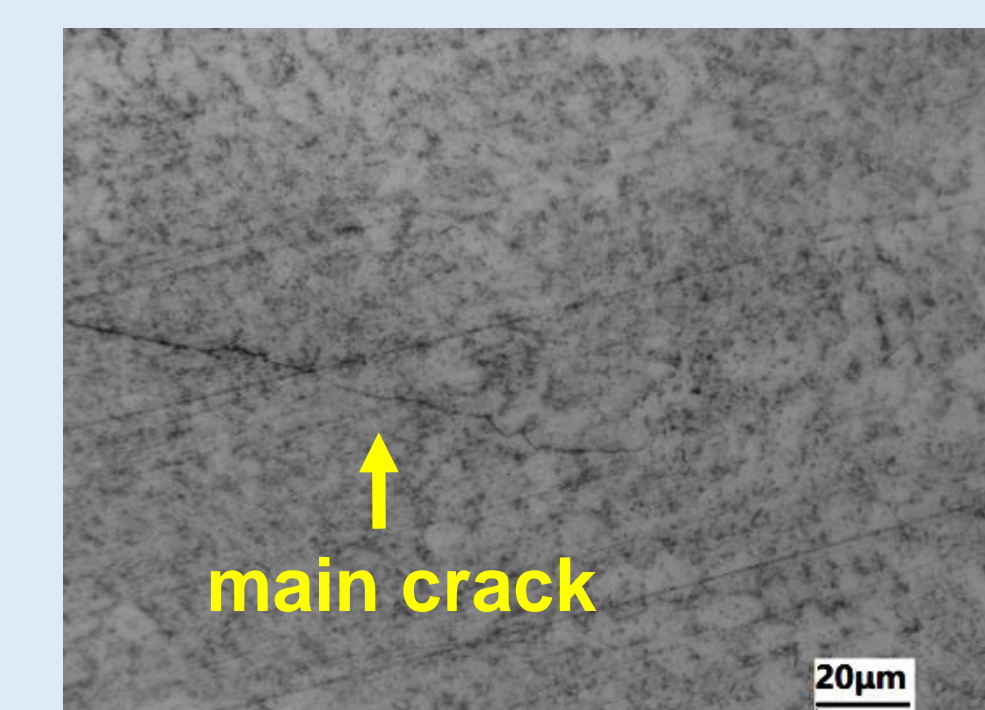


Weld metal

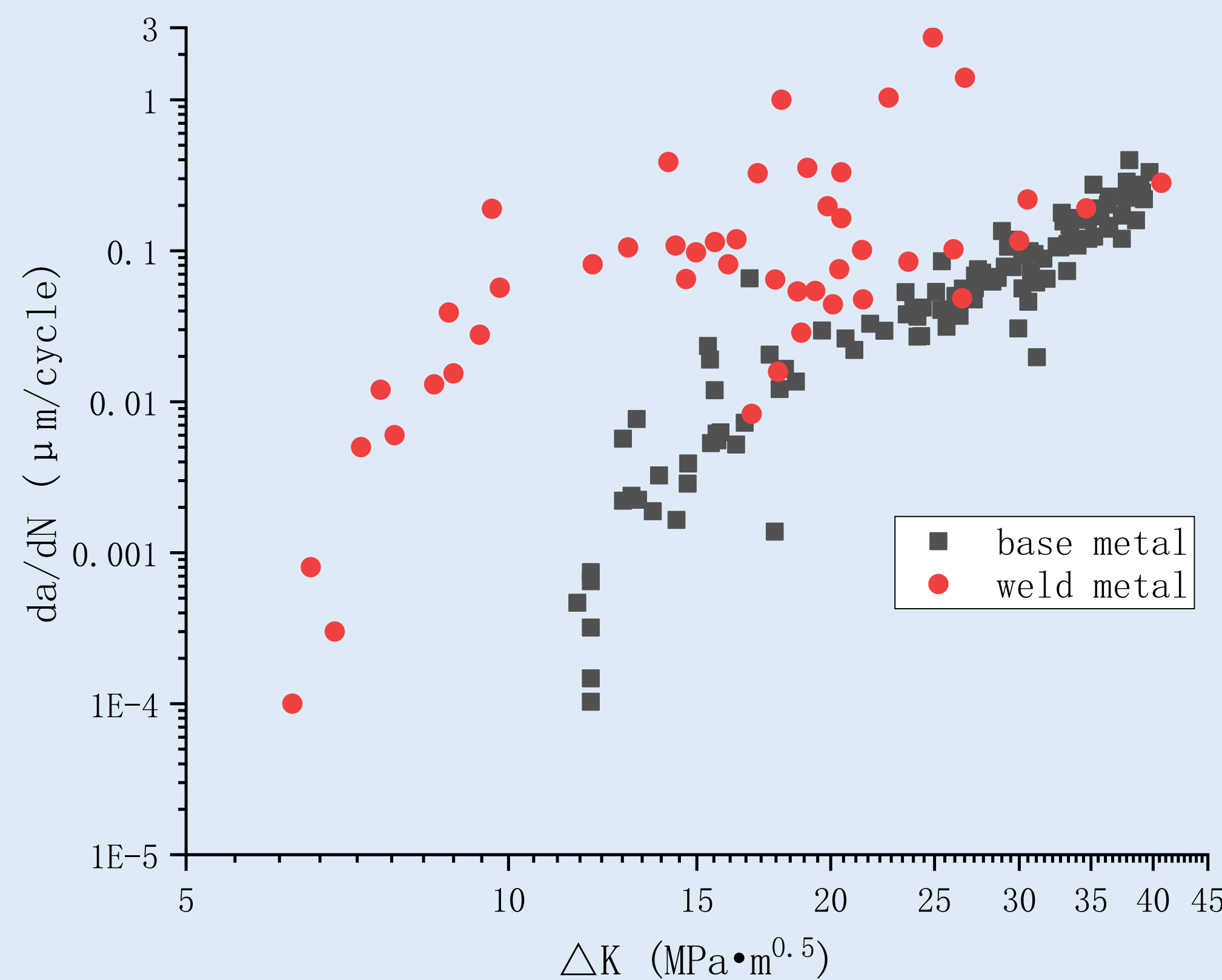
- ◆ The 18Ni maraging steel weld consists of weld metal, heat affected zone (HAZ) and base metal.
- ◆ The optical microstructure of base metal is equiaxed prior austenite grains and the optical microstructure of weld metal is dendrite.
- ◆ Massive reversed austenite phases exist only in the interdendritic region of weld metal, where the elements of Mo, Ti are enriched. (indicated by yellow arrow)



Crack growth path in base metal



Crack growth path in weld metal

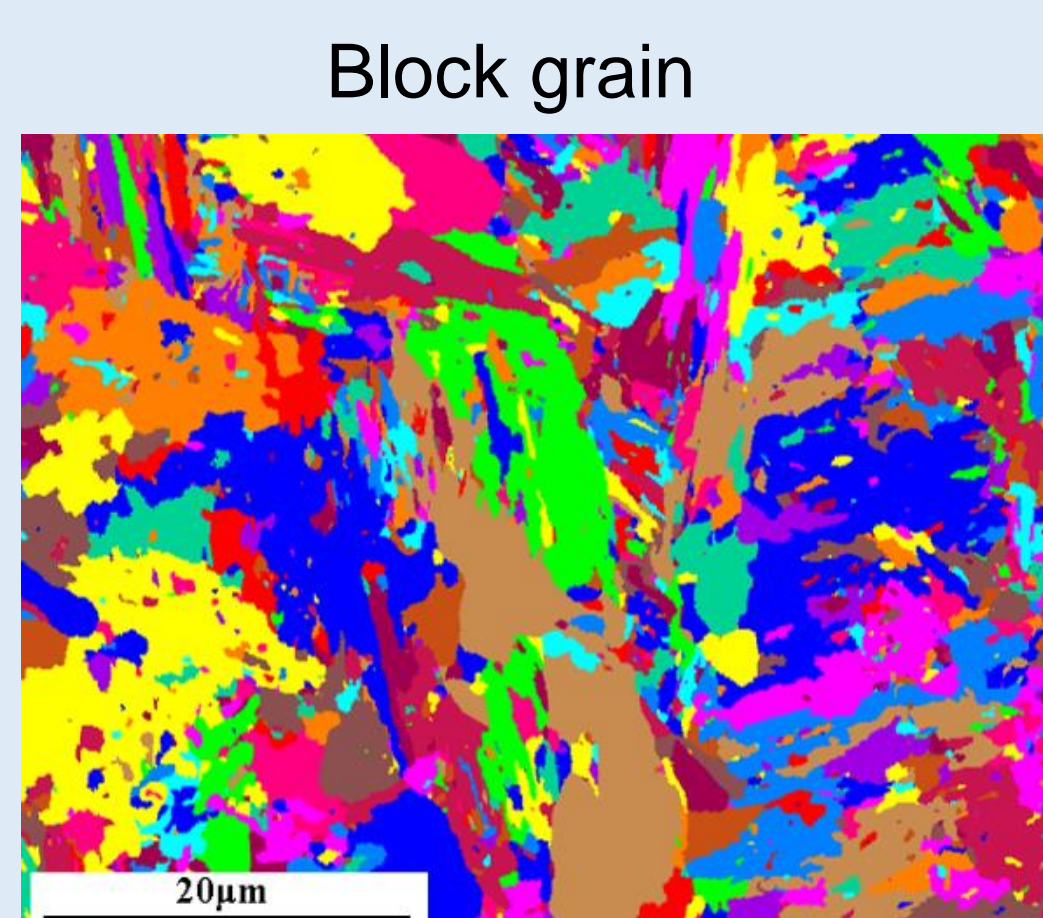


Fatigue crack growth rate vs. stress intensity range

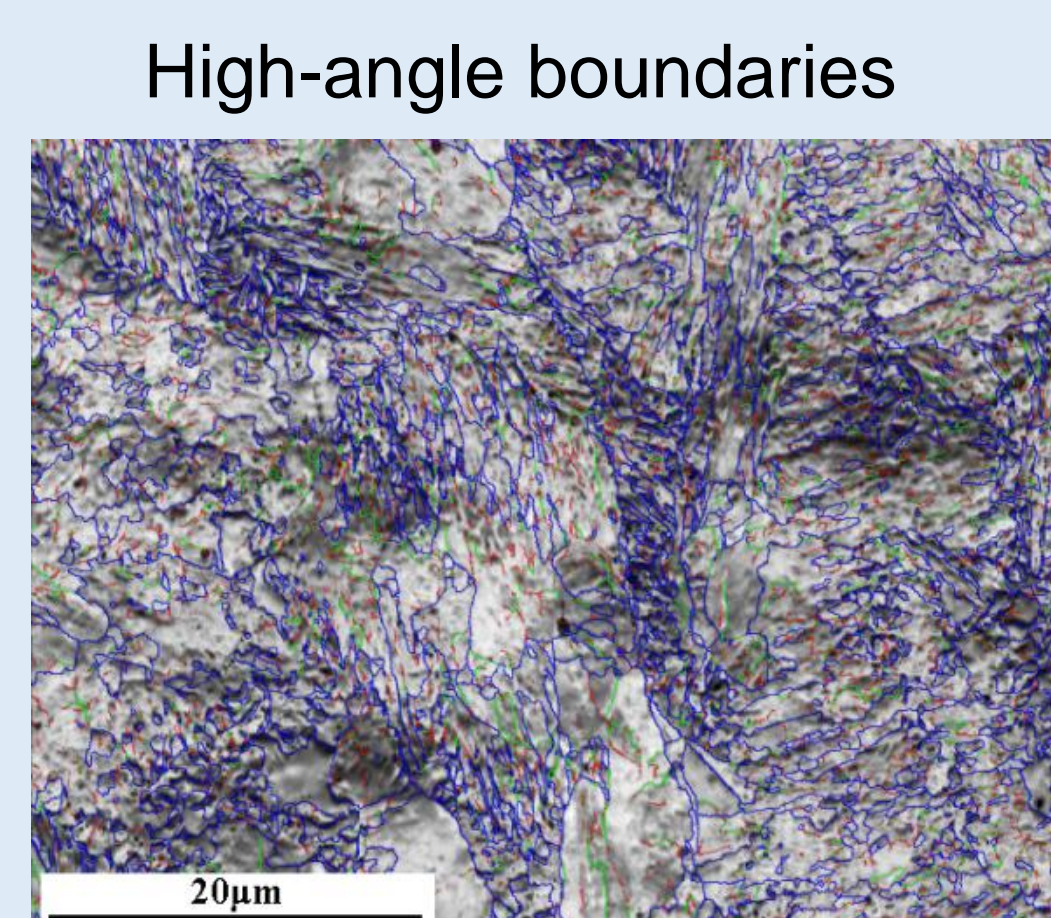
- ◆ The coalescence effect between main crack and some microcracks near main crack tip inevitably occur in base metal. However, no other cracks or microcracks are involved in main crack growth in weld metal.
- ◆ Fatigue small crack growth behaviour of weld metal is significantly faster than that of base metal, and the discrepancy between them is even more obvious near the threshold.

## DISCUSSION AND CONCLUSION

- Compared with base metal, the larger average size of block grains of weld metal is expected to further promote the crack growth.
- Compared with base metal, the lower density of high-angle boundaries of weld metal has less efficiency of microstructure barriers to crack growth.

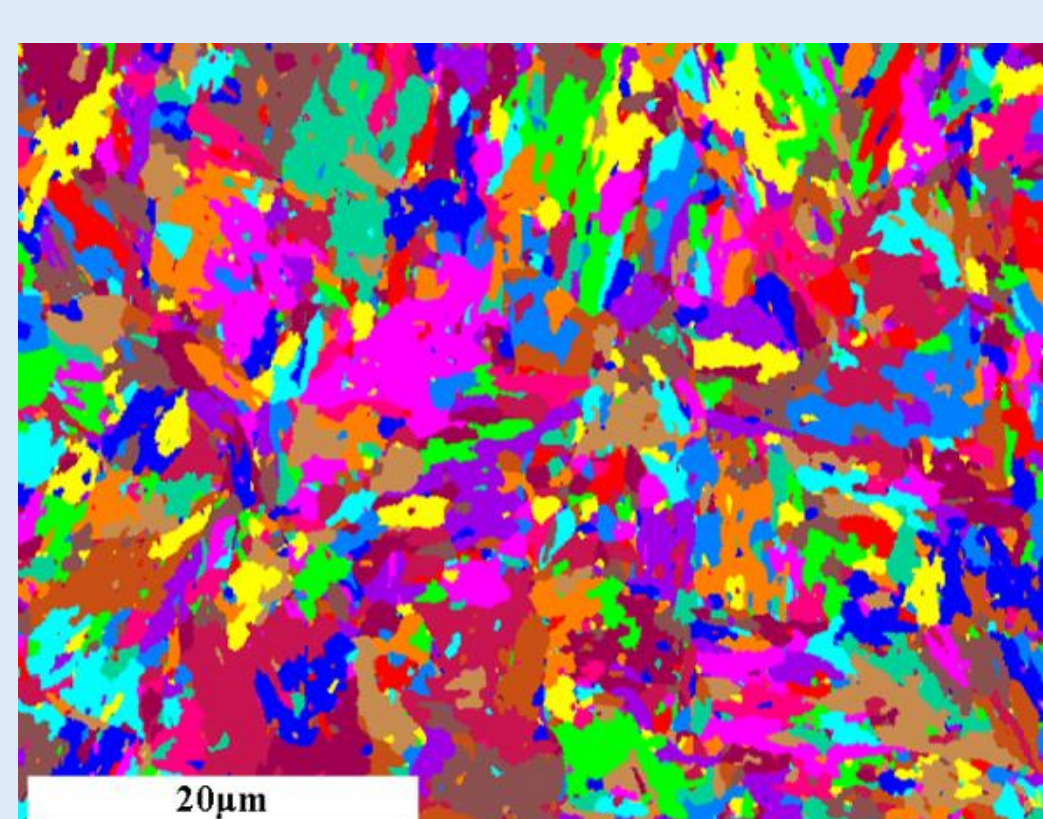


Block grain

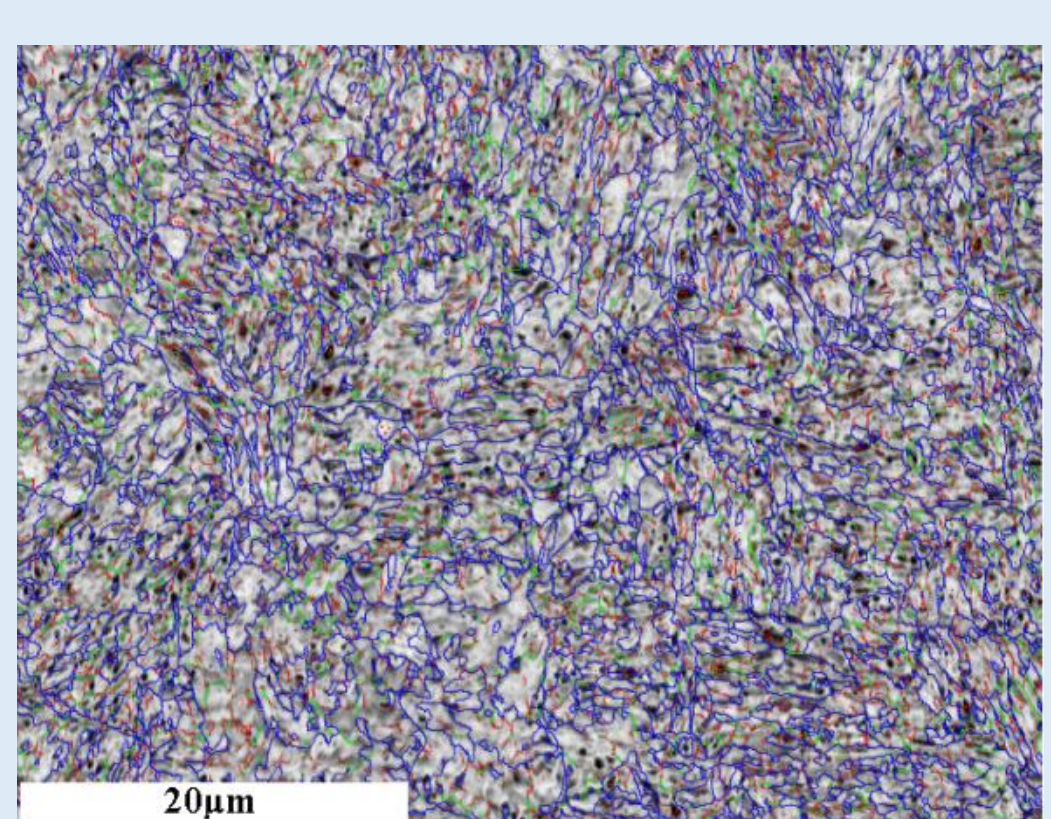


High-angle boundaries

Weld metal



Base metal



Boundaries: rotation angle

	Min	Max
Red	2°	5°
Green	5°	15°
Blue	15°	180°