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**WELDING OF HELIUM-DOPED TYPE  
316 STAINLESS STEEL\***

CONF 8708138--6-Vugraphs

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## BACKGROUND

- HELIUM EMBRITTLEMENT HAS BEEN OBSERVED IN IRRADIATED STAINLESS STEELS IN TENSILE TESTS AT TEMPERATURES ABOVE 600°C FOR CONCENTRATIONS AS LOW AS 0.1 appm
- AT TEMPERATURES BELOW 600°C, He HAS A SMALL EFFECT ON TENSILE PROPERTIES OF IRRADIATED STAINLESS STEELS

## BACKGROUND (continued)

- RECRYSTALLIZATION IN THE HEAT AFFECTED ZONE (HAZ) OF A WELD IS PREDICTED TO CONCENTRATE He AT GRAIN BOUNDARIES OF COLD WORKED STAINLESS STEELS CAUSING SEVERE EMBRITTLEMENT
- EVEN IN ANNEALED MATERIAL, SEGREGATION OF He TO GRAIN BOUNDARIES DURING WELDING COULD LEAD TO EMBRITTLEMENT

## APPLICATION

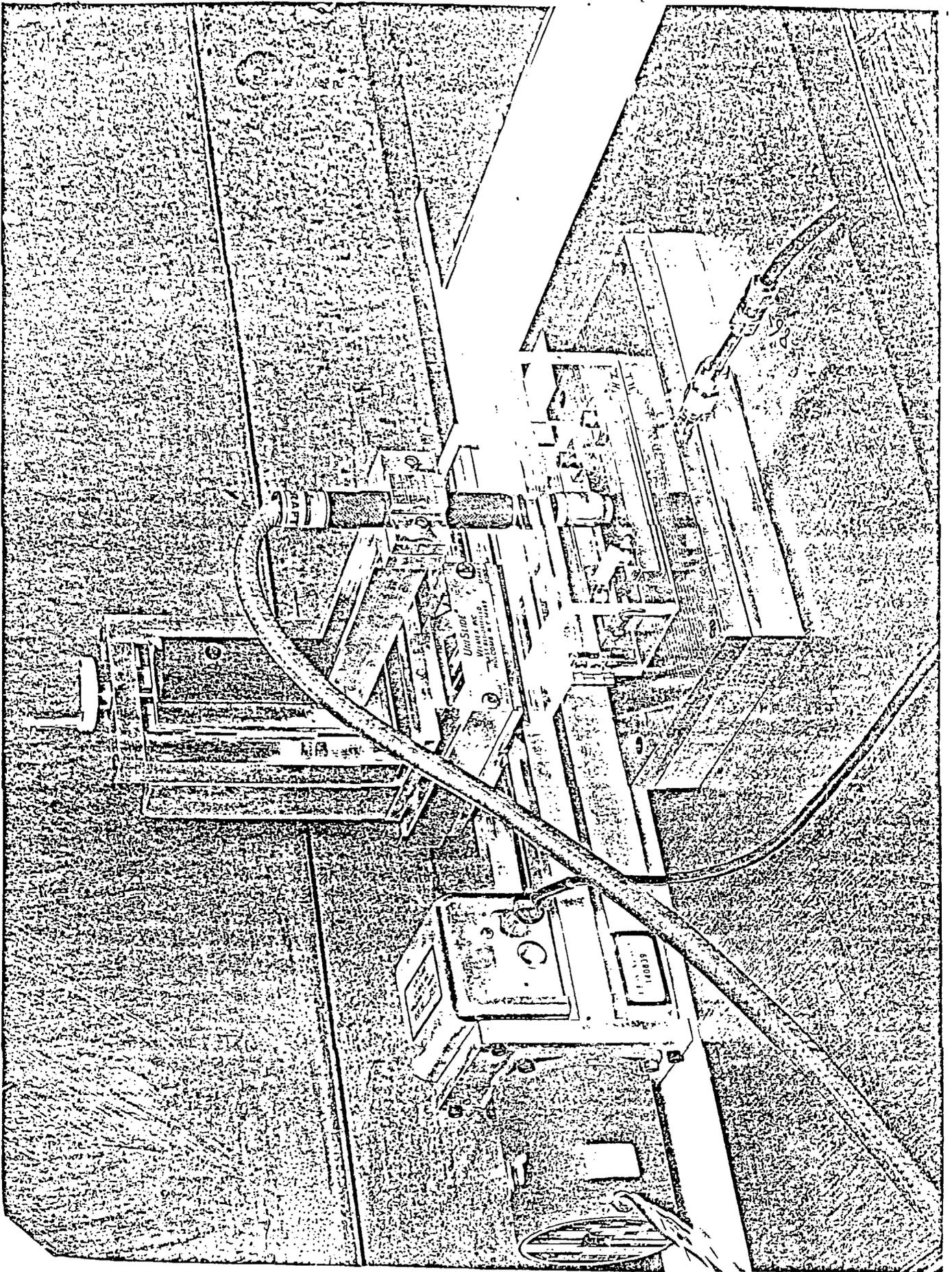
- ⊕ FUSION REACTORS WILL REQUIRE REMOTE MAINTENANCE ON IRRADIATED STRUCTURES
- ⊕ THE IRRADIATED MATERIALS WILL HAVE SUBSTANTIAL CONCENTRATIONS OF He AND WILL REQUIRE WELDING

## OBJECTIVE

THE PRESENT EXPERIMENT IS DESIGNED TO INVESTIGATE THE EFFECT OF He ON MECHANICAL PROPERTIES OF WELDS IN TYPE 316 STAINLESS STEEL

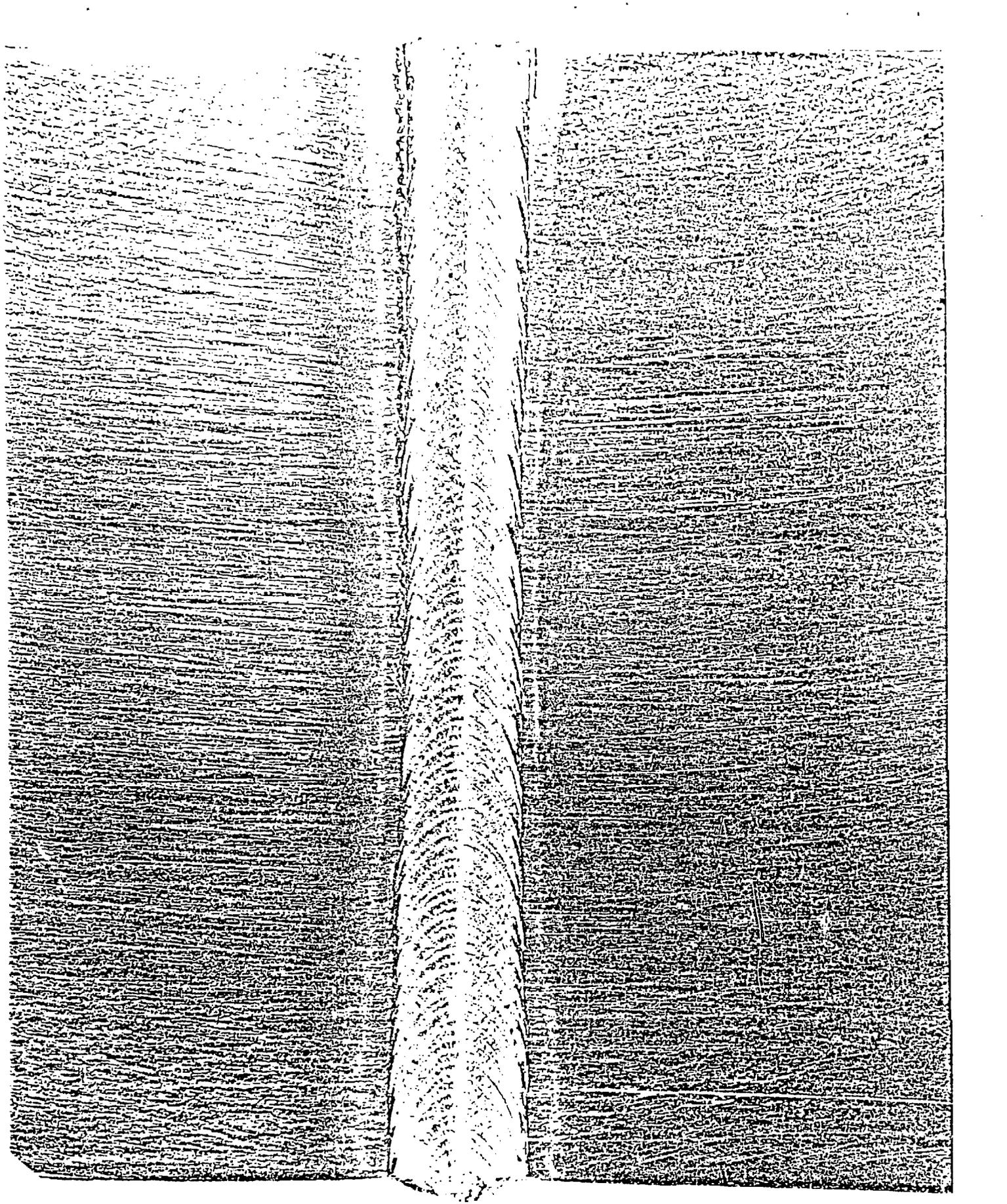
## PRESENT EXPERIMENT

- TRITIUM-TRICK ( ${}^3\text{H} \rightarrow \beta^- + {}^3\text{He}$ ) IS USED TO INTRODUCE He TO LEVELS OF 27-200 appm
- WELD USING GAS TUNGSTEN (W) ARC (GTA)

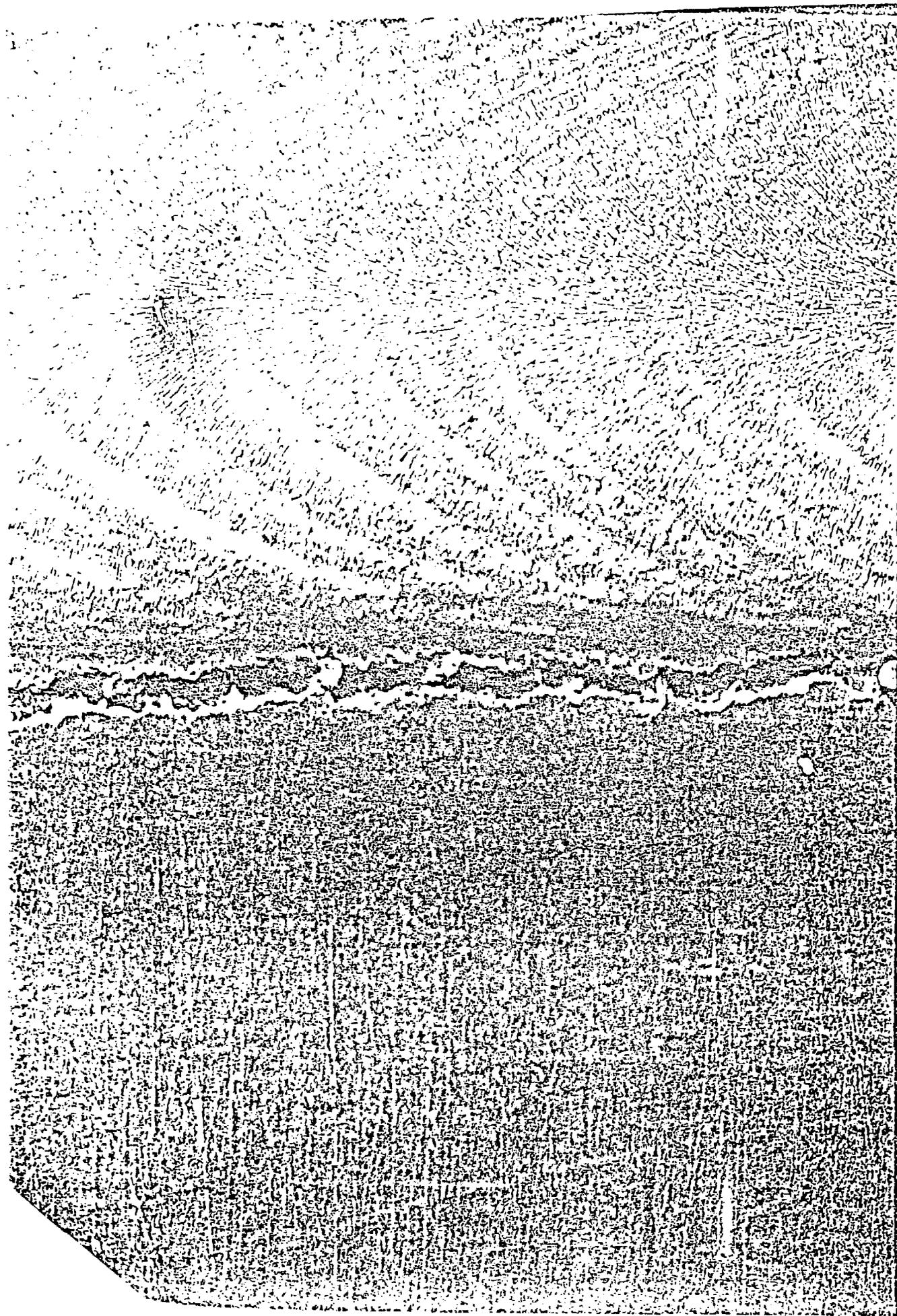


## RESULTS

- NO CRACKS WERE OBSERVED IN THE FUSION ZONE
- INTERGRANULAR CRACKS WERE OBSERVED IN THE HEAT AFFECTED ZONE (HAZ)



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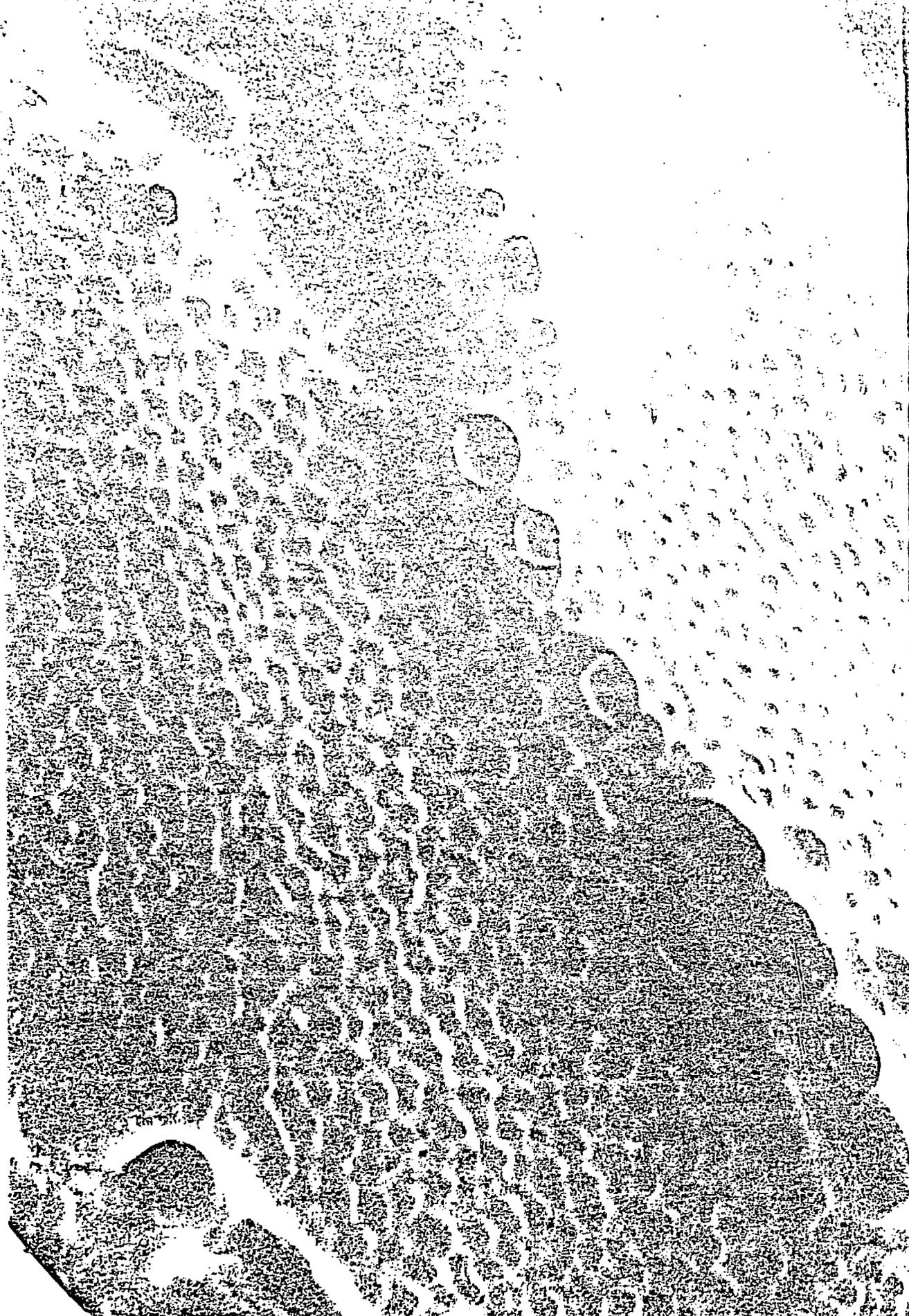




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## FUTURE DIRECTIONS

- INVESTIGATE HIGHER LEVELS OF He
- MORE CAREFULLY EXAMINE HAZ USING:
  - OPTICAL METALLOGRAPHY
  - SCANNING ELECTRON MICROSCOPY (SEM)
  - TRANSMISSION ELECTRON MICROSCOPY (TEM)

TO DETERMINE DISTRIBUTION OF He

- SUGGEST METHODS TO REDUCE CRACKING AND EMBRITTLEMENT