

# International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

Balapur P.O., Hyderabad – 500005, Telangana, India



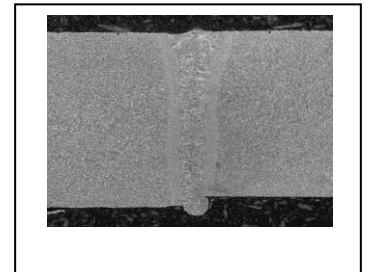
## Autogenous Laser Welding of Modified 9Cr-1Mo steel

### Overview

Modified 9Cr-1Mo (P91) steel finds its usage in high temperature applications such as in supercritical and ultra super critical power plants. The weldability issues in P91 steel such as formation of delta ferrite in the fusion zone reducing the creep properties, hydrogen induced cracking due to high hardness in as-welded condition and Type-IV cracking in the intercritical zone away from the Heat Affected Zone (HAZ) are expected to be obviated through low heat input welding technique. Autogenous laser welding a low heat input technique when applied on 6 mm thick P91 steel plates using high beam quality (Gaussian,  $K > 0.96$ ) DC035 slab CO<sub>2</sub> laser using a focal spot size of 180  $\mu\text{m}$  could successfully address the above stated challenges.

### Key Features

- Welds free from both hot and cold cracks and also fusion zone free of delta ferrite and no intercritical soft zone.
- The welds have 100 % joint efficiency with failure away from the weld in tensile testing and the welds have sufficient bend ductility.



Laser weld Macrograph-P91 steel

### Potential Applications

- Power plant
- Nuclear industry



Laser Welded 9Cr1Mo plates after bend test

### Intellectual Property Development Indices (IPDI)

- Performance and stability are validated at coupon level

| Status | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
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### Major Publications

1. B. Shanmugarajan, G. Padmanabham, Hemant Kumar, S.K. Albert and A.K.Bhaduri, "Autogenous laser welding investigations on modified 9Cr-1Mo (P91) steels", **Science & Technology of Welding and Joining**, Vol.6, No.6, 2011, p528

#### Centre for Laser Processing of Materials (CLPM)

ARCI, Balapur PO., Hyderabad 500005, Telangana, India  
Tel : +91 40 24443167 / 24452329; Fax : +91 40 24442699

Email: director[at] arci [dot] res [dot] in / gp [at] arci [dot] res [dot] in / phani [at] arci [dot] res [dot] in