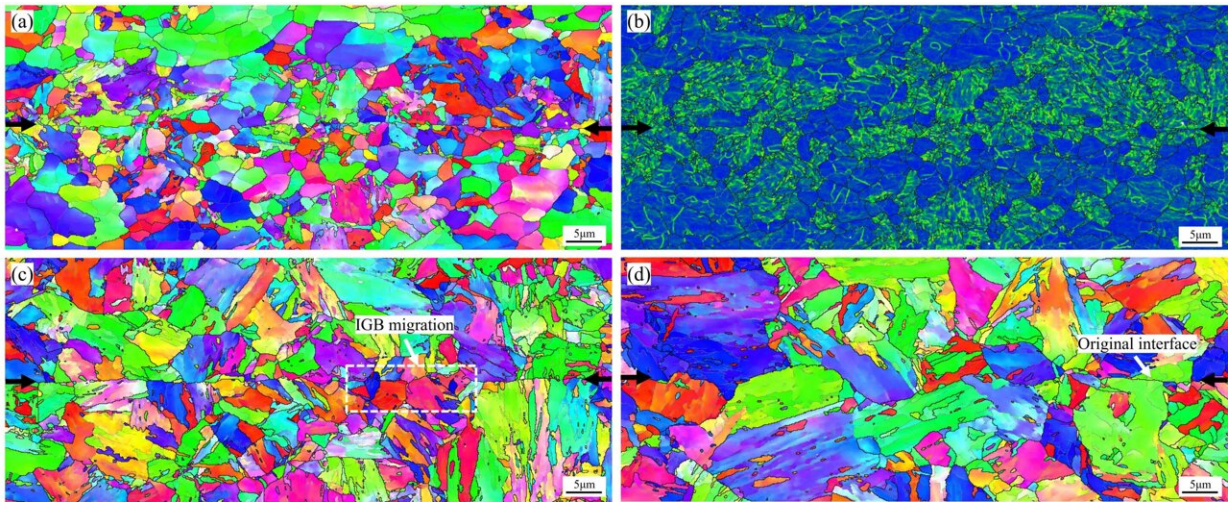
Hot compression bonding helps achieve seamless CLAM steel joint

May 9 2024, by Zhang Nannan

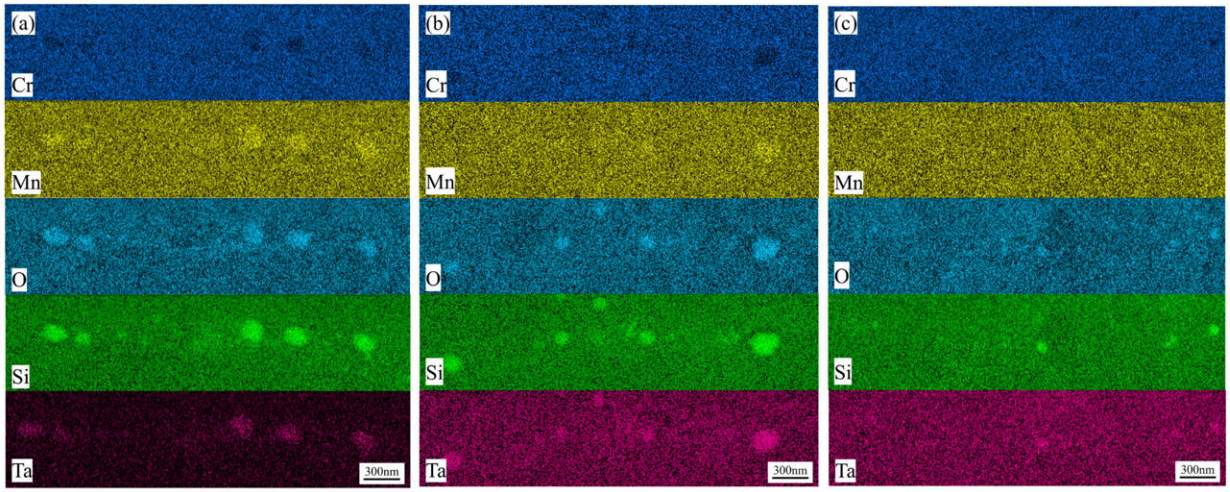


EBSD images of interfaces at difference HCB temperatures: (a-b) 850°C, (c) 950°C, (d) 1,050°C. Credit: Bai Yunfei

China low activation martensitic (CLAM) steel, as a typical reduced activation ferritic/martensitic steel, is the main candidate structural material for fusion reactors due to its low activation, high mechanical properties, irradiation resistance and corrosion resistance. However, weld uniformity is difficult to achieve with a conventional welding method, which tends to coarsen the martensitic slat, and the performance of the joints is usually lower than that of the base material.

In view of this, a research team led by Prof. Huang Qunying from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences (CAS), in collaboration with researchers from the Institute of Metal Research of CAS, has conducted a study on the evolution of interfacial microstructure and oxides in CLAM steel by hot compression bonding (HCB). The study is published in the journal *Materials Characterization*.

They developed the HCB method to realize effective joining of components by promoting the interfacial grain boundary migration and recrystallization under the combined effect of thermal coupling. The results showed that the interfacial oxide and micro-voids could be eliminated after the HCB process. The atomic-scale interfacial bonding could be achieved so that the bonding interface would be completely healed.



EDS results of oxides at the interfaces after different holding time at 1,100°C: (a) 0.5 h, (b) 2 h, (c) 6 h. Credit: Bai Yunfei

They also tested and observed the microstructure and oxides at the

interfaces of the specimen via different conditions of HCB to see how they affected the properties. After a subsequent two-hour holding treatment at 1,100°C, the tensile properties of the joint compressed with 20% deformation at the same temperature were able to match those of the matrix. These results suggest that the HCB technology removes the original CLAM-steel interface traces and prevents the weld seam from influencing the component properties.

This study provides an important reference for the efficient bonding of CLAM steel and the production of large components without joints.

More information: Yunfei Bai et al, Evolution of interfacial microstructure and oxides of CLAM steel by hot compression bonding, *Materials Characterization* (2024). DOI: 10.1016/j.matchar.2024.113848

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