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| **Title:** | Analysis of sintering and bonding of ultrafine WC powder and stainless steel by hot compaction diffusion bonding | | |
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| **Abstract:** |  |
| Bonding between tungsten carbide and steel is a challenging task due to their large difference of physical properties. Previous reports were based on solid state bonding. In this study, a powder-solid mechanism was employed for analysing the sintering and bonding process of ultrafine WC (with 8% Co added as binder) powder and solid stainless steel (SS 304). A novel manufacturing mechanism of hot compaction diffusion bonding (HCDB) was implemented to facilitate the bonding process. The influence of temperature varying from 1160 to 1220 °C was investigated with an interval of 20 °C. The experiment is conducted in a vacuum environment at constant pressure of 160 MPa. Under simultaneous effects of temperature and pressure, WC powder was solidified and a diffusion bonding was realised with SS 304. The bonding interface is characterised by three distinctive features, namely properly bonded area, crack appearance and formation of diffusion layer. Generation of micro cracks are examined in the form of single long micro crack, cluster of micro cracks and crack in WC region. An average hardness of 1971 HV was found at 1220 °C, and the maximum mechanical bonding shear strength achieved was 172 MPa. The microstructure morphology, composition distribution, bonding characteristics and crack formation, diffusion mechanism and mechanical properties of the composite bimetal were examined. The fabricated composite bimetal has the potentials in the applications where high hardness and high strength are required simultaneously. | |