

Ni-Based Hardfacing Alloy Reinforced with Fused Eutectic Tungsten Carbide Deposited on Infiltrated WC-W-Ni Substrate by Oxyacetylene Welding

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Abstract : The body of PDC (polycrystalline diamond compact) drill bit can be manufactured from two different materials, steel and tungsten carbide matrix. Commonly the steel body is produced by machining, thermal spraying a bonding layer and hardfacing of Ni-based matrix reinforced with fused eutectic tungsten carbide (WC/W₂C). The matrix body bit is manufactured by infiltrating tungsten carbide particles, with a Copper binary or ternary alloy. By erosion-corrosion mechanisms, the PDC drill bits matrix undergoes severe damage, occurring particularly around the PDC inserts and near injection nozzles. In this study, we investigated the possibility to repair the damaged matrix regions by hardfacing technic. Ni-based hardfacing alloy reinforced with fused eutectic tungsten carbide is deposited on infiltrated WC-W-Ni substrate by oxyacetylene welding (OAW). The microstructure at the hardfacing / matrix interface is characterized by SEM- EDS, XRD and micro hardness Hv0.1. The hardfacing conditions greatly affect the dilution phenomenon and the distribution of carbides at the interface, without formation of transition zone. During OAW welding deposition, interdiffusion of atoms occurs: Cu and Sn diffuse from infiltrated matrix substrate into hardfacing and simultaneously Cr and Si alloy elements from hardfacing diffuse towards the substrate. The dilution zone consists of a nickel-rich phase with a heterogeneous distribution of eutectic spherical (Ni-based hardfacing alloy) and irregular (matrix) WC/W₂C carbides and a secondary phase rich in Cr-W-Si. Hardfacing conditions cause the dissolution of banding around both spherical and irregular carbides. The micro-hardness of interface is significantly improved by the presence of secondary phase in the inter-dendritic structure.

Keywords : dilution, dissolution, hardfacing, infiltrated matrix, PDC drill bits

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