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A Review Joining of Dissimilar Duplex AISI 2205 and Austenite AISI 321 Stainless Steel Using Gas Tungsten Arc Welding

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Abstract

The joining of AISI 2205 duplex and AISI 321 austenitic stainless steels involves complex metallurgical hurdles due to significant disparities in thermal properties, chemical composition, and solidification mechanics. This review evaluates the efficacy of Gas Tungsten Arc Welding, with a specific focus on the pulsed current technique as a strategic method for managing heat input and achieving a refined grain structure. The analysis explores the evolution of microstructures and the subsequent impact on mechanical integrity specifically tensile strength and hardness and corrosion resistance in these bimetallic joints. It highlights how critical factors such as welding parameters, filler metal selection, and post-weld heat treatments dictate the phase balance (austenite-ferrite ratio) and pitting resistance. By establishing a clear link between process optimization and enhanced joint performance, the review identifies current research gaps and proposes future advancements, including hybrid welding, advanced numerical modeling, and real-time in-situ monitoring to produce high-performance dissimilar stainless steel joints.

Keywords

Duplex Stainless Steel, Austenitic Stainless Steel, Pulsed Current Gas Tungsten Arc Welding, Dissimilar Welding, Microstructure Evolutione

Biographies

Nurulfatin Fasihah Binti Roslan is a Mechanical Engineering professional with over five years of experience in quality control, oil diagnostics, and technical operations within the energy and manufacturing sectors. She currently serves as a Technician/Analyst at TNB Research Sdn. Bhd., specializing in transformer oil analysis, predictive maintenance, and laboratory quality assurance in accordance with ISO/IEC 17025 standards. Her expertise includes Dissolved Gas Analysis (DGA), Non-Destructive Testing (NDT), preventive maintenance, calibration management, and the application of the 7 QC Tools to enhance reliability and operational efficiency. She has contributed to laboratory process improvements that strengthened testing accuracy and supported consistent performance in international inter-laboratory studies. Previously, she worked in quality control at Akashi Kikai Industry (M) Sdn. Bhd., focusing on root cause analysis and corrective action implementation to improve product integrity and manufacturing performance. She holds a Bachelor's Degree in Mechanical Engineering from Universiti Teknologi

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Malaysia and is currently pursuing a Master of Philosophy in Mechanical Engineering. She is a registered Graduate Engineer with the Board of Engineers Malaysia and a Graduate Technologist under the Malaysia Board of Technologists, with research interests in predictive maintenance, reliability engineering and advanced material engineering.

Mohd Faridh Ahmad Zaharuddin is a senior lecturer and a coordinator in the Master of Mechanical Engineering, special track for manufacturing and welding, at the Faculty of Mechanical Engineering, University Teknologi Malaysia, Malaysia. As a director of Authorise Training Body Fakulti Kejuruteraan Mekanikal, his work is focusing in developing new curriculum in university for Education and Qualification of Welding Personnel. His research interests include welding especially in laser weld and friction stir welding, and adaptive manufacturing. He has been appointed as Advisory Board for Welding Institute of Malaysia, and also International Advisory Editor at Journal of Welding and Joining, Korea. With his extensive experience and research, Mohd Faridh Ahmad Zaharuddin significantly contributes to the advancement of knowledge in the fields of welding and the adaptive manufacturing for Education and Qualification of Welding Personnel

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