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Surface modification of low-alloy steels by a multifunction cavitation

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Alloy steels for machine structural are used for industrial equipment. However, the operating environment is often harsh, requiring the development and application of various surface treatments. The authors focus on the use of Water Jet Cavitation (WJC) with ultra-sonication. WJC technology enables the generation of high pressure during cavitation collapse near the surface when a water jet ejected from a nozzle impacts a metal surface. This pressure causes a slight deformation in the impacted surface region and introduces a compressive residual stress due to the elastic constraints of the underlying and surrounding metal. If ultrasonic irradiation is applied to WJC bubbles with diameters of several hundred microns, the bubbles are subjected to alternating high and low sound pressures which lead to a high-pressure and high-temperature reaction field. This technique is referred to as Multifunction Cavitation (MFC). In present study, the compressive residual stress and corrosion resistance of Cr-Mo and Ni-Cr-Mo steels were improved by MFC treatment. Moreover, the authors compared conventional WJC technology to MFC technology. MFC was found to lead to higher compression residual stresses and higher corrosion resistances compared to conventional WJC. The corrosion resistance was revealed by the formation of an oxide film through selective oxidation and the concomitant reduction of surface defects. The oxide coating is formed by a reaction between the dissolved oxygen in water with Cr on the metal surface during processing.

Biography

Masataka Ijiri has completed his Bachelor of Engineering and Masters in Mechanical and System Engineering. Specialist in Materials Engineering and has Engineering Doctor's degree at Okayama University.

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