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WORKING PAPER

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# Fabrication of Featured FSP Tool by Reverse- $\mu$ EDM Process and its Effect on FSP Characteristics of Cold Sprayed Inconel 718 Super Alloy

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**Title:** Fabrication of Featured FSP Tool by Reverse- $\mu$ EDM Process and its Effect on FSP Characteristics of Cold Sprayed Inconel 718 Super Alloy

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**Abstract (150 words, Font 12):** The use of triple-spiral micro-grooves on the shoulder surface of the friction stir welding/processing (FSW/P) tool has shown the advantage of improved material flow during the process. However, generating features on materials such as tungsten carbide (WC), which is a robust but very hard tool material, is a challenging task through conventional manufacturing routes. In this regard, the feasibility of fabricating triple-spiral micro-grooves on the shoulder surface of a WC made FSP tool through reverse-micro-electric discharge machining (R- $\mu$ EDM) is performed. Titanium, copper, stainless steel and brass have been used as the four tool-plate materials of R- $\mu$ EDM. While titanium showed the best performance in terms of achieving accurate features, with brass as the tool-plate material, the fastest machining was obtained. The fabricated featured tool is then used for FSP of cold-sprayed Inconel 718 superalloy layer with the goal of improving the cold-spray deposit characteristics. FSP characteristics of cold sprayed Inconel 718, namely porosity, corrosion and wear are comparatively assessed with respect to featured and flat shoulder tools. It has been observed that FSP by featured tool has shown better microhardness, corrosion and wear resistance, and porosity at the processed zone.

**Purpose:** To understand the fabrication of featured FSP Tool by Reverse- $\mu$ EDM Process and its Effect on FSP Characteristics of Cold Sprayed Inconel 718 Super Alloy

**Design/Methodology/ Approach:** Experimental

**Findings:** Considering the minimum tool wear rate (TWR) and hence accurate dimension of the triple-spiral feature on the FSP tool shoulder, the titanium tool plate was found to be the best. Between featured and flat shoulder tools, the featured one showed higher wear resistance and hardness because of more densification and finer grain size

**Research Limitations/ implications:** The research applicability is limited to tungsten carbide rods for FSP tools and cold-spray additively manufactured Inconel 718 superalloy

**Originality/ Value:** Feasibility of fabricating triple-spiral micro-grooves on the shoulder surface of a WC-made FSP tool through reverse-micro-electric discharge machining (R- $\mu$ EDM). FSP of cold-sprayed Inconel 718 superalloy layer with the goal of improving the cold-spray deposit characteristics.

**Keywords:** Friction Stir Processing, Triple spiral micro groove, Reverse- $\mu$ EDM, Cold spray, Inconel 718 superalloy

**Description:** Paper writing and corrections are underway.