Surface Quality Enhancement of Metallic Tubes by A Novel Flocking-Fiber Coated Magnetic Tool

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High-quality internal surfaces are critical in aerospace, medical devices, and precision engineering industries. Internal polishing is generally employed to enhance the performance and longevity of components with such surfaces by minimizing friction, wear, and corrosion. Magnetically driven internal finishing (MDIF) is a promising technique for improving surface quality of internal surfaces. However, the fixed-abrasive tools used in MDIF limit its best achievable surface roughness to >100 nm Ra. Hence, this study proposed an innovative method employing magnetic tools coated with flocking fibers to achieve a more flexible and gentle polishing process compared to the existing MDIF. With the assistance of abrasive slurries, the new magnetic tool achieves a surface roughness of approximately 60 nm Ra on a 316L stainless steel tube. The repeatability of the newly-developed tools was validated. And the evolution of material removal depth and surface roughness against the polishing time was investigated. A section polishing experiment was also conducted to explore the possibility of polishing larger surfaces by the new polishing tool. The proposed method expands the boundary of MDIF techniques and may find potential applications in aerospace and optical industries.