**ABSTRACT:**

# Ultra-Strong and Corrosion-Resistant Amorphous-Nanocrystalline Stainless Steel Microfibers

Baran Sarac[1], Elham Sharifikolouei[2], Yonghui Zheng[3], Peter Hofer-Hauser[1]
[1]Institute of Casting Research, Montanuniversität Leoben, A-8700 Leoben, Austria
[2]Center for Translational Research on Autoimmune and Allergic Diseases - CAAD, Department of Health Sciences, Università del Piemonte Orientale UPO, 28100 Novara, Italy
[3]Key Laboratory of Polar Materials and Devices (MOE), Department of Electronics, East China Normal University, Shanghai 200241, China

Stainless steels are extensively utilized in industry owing to their high corrosion resistance and mechanical integrity. Nonetheless, the stability of their passive oxide layers is often compromised in aggressive media, such as saline environments, which consequently restricts their operational lifespan. Fabrication of amorphous and nanocrystalline stainless steel microfibers was successfully executed utilizing a modified multi-nozzle melt-spinning technique, achieving ultra-high cooling rates up to 108 K/s. The synthesized fully amorphous 316-type stainless steel microfibers demonstrate exceptional corrosion resistance, evidenced by a remarkably low passive current density of 0 .77 × 10-5 A cm-2 in 3.5 wt% NaCl and stable passivity even at elevated temperatures of 50°C. Electrochemical impedance spectroscopy conducted before and after polarization at 50 °C reveals an increase in charge transfer resistance as well as in double-layer admittance, indicating the development of a double layer on the external surface as a result of $Cl^-$ ion accumulation [1]. Cross-sectional TEM-HAADF characterization demonstrated that the as-quenched 316-type stainless steel microfibers possess a largely amorphous structure, as evidenced by the diffuse diffraction rings in the FFT patterns. Upon subsequent heat treatment, nanocrystalline austenitic grains developed, accompanied by localized elemental partitioning—most notably Ni enrichment—which is consistent with the coexistence of crystalline and amorphous domains [2]. The amorphous microstructure markedly enhances the mechanical performance, with hardness increasing from 2.5 GPa in conventional stainless steel to 8.2 GPa in the amorphous form. Upon heat treatment, a nanocrystalline–amorphous composite is generated, further raising hardness to 14.2 GPa. This dual-phase architecture effectively restricts dislocation mobility and localizes shear transformation zones, thereby improving strength while maintaining corrosion resistance [3]. The results indicate that amorphous and nanocrystalline stainless steel microfibers exhibit exceptional potential for applications demanding superior mechanical strength and corrosion resistance, including marine engineering, biomedical devices, and structural composites.

Their scalable fabrication process and adjustable material characteristics pinpoint their feasibility as candidates for advanced industrial applications.

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