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Title: Pulse electrodeposition of nanocrystalline Ni coatings for turbomachinery applications

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1. Brief summary of major findings

Pulse electrodeposition (PED) has been successfully employed to fabricate various **nanocrystalline (nc)** Ni coatings on 304 stainless steel (304SS) plates to imitate practical utilization of coatings on turbomachinery components in lab-scale. The Ni coatings are robustly bonded to substrates by electropolishing the 304SS in acidic solutions, which remove oxide layer and surface roughness prior to coatings. The macroscopic appearance displays bright and glossy, in agreement with the microscopy examination, as a result of the addition of chloride salts, which were deliberately introduced to improve deposition efficiency and ductility. The grain size of nc Ni coatings proved to be controllable over a wide range, varying from 1.0 μm to 48 nm, by tailoring mean current density over 2 to 10 A/dm^2 . The PED rate was $\sim 1.1 \mu\text{m}/\text{min}$ at a current density of 10 A/dm^2 . The nanoindentation results suggest a strong dependence of hardness on the average grain size. The nc Ni yields the highest hardness of $\sim 6 \text{ GPa}$ at an average grain size of 48 nm due primarily to grain boundary strengthening. Moreover a large number of growth twins in the as-deposited coatings may affect their plastic deformation mechanisms, wear resistance and friction coefficient, to be investigated in our future works.