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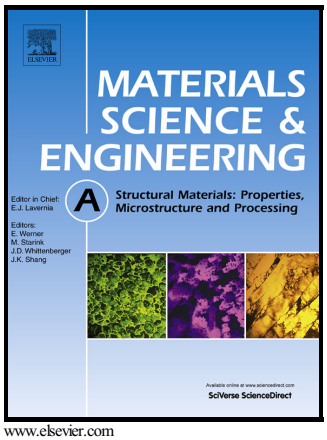

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Suppressing unstable deformation of nanocolloidal crystals with atomic layer deposition

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ABSTRACT

Despite their useful photonic properties, poor mechanical robustness hinders the application of nanocolloidal crystals (NCCs). Understanding the mechanical behavior of NCCs is critical to propose effective reinforcement techniques. We find that as-assembled NCCs exhibit unstable deformation, manifested as pop-ins upon nanoindentation. By deepening indentation, the unstable deformation mode transitions from NC dislodging to shear band (SB) formation. We find that alumina atomic layer deposition (ALD) significantly suppresses NC dislodging and SB formations in NCCs by increasing interparticle bonding.

Keywords: Nanoindentation; Shear bands; Mechanical characterization; Nanostructured materials; Granular materials

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1. Introduction

Although the photonic properties of nanocolloidal crystals (NCCs) make them