MECHANICAL BEHAVIOUR AND SIZE EFFECTS OF POLYMER/AMORPHOUS NiB COMPOSITES WITH 3D MICRO-ARCHITECTURES

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Micro-architectured materials are a new class of hierarchical cellular material with outstanding properties. By designing advantageous cellular geometries and combining the material size effects at the nanometer scale, lightweight hybrid micro-architectured materials with hierarchical cellular structures and tailored structural properties are achieved. Previous papers have reported the mechanical properties of ceramic/polymer composites but few studies have examined the properties of similar structures with metal coatings instead of ceramic. To estimate the mechanical performance of polymer cellular structure reinforced with a metal coating, we combined 3D laser lithography and electroless deposition of an amorphous layer of NiB to produce metal/polymer hybrid structures. In this poster, the fabrication of 3D hybrid structures by electroless deposition aiming at achieving high and yet low density material will be presented. We also studied the mechanical response of micro-architectured structures as a function of the architecture design and the thickness of the amorphous NiB layer on their deformation mechanisms. In situ SEM microcompression experiments revealed a change in the deformation behavior with the NiB layer thickness, suggesting that the deformation mechanism and the buckling behavior are controlled by the size induced brittle-to-ductile transition in the NiB layer. In addition, the energy absorption properties demonstrate the possibility of tuning the energy absorption efficiency with adequate designs.

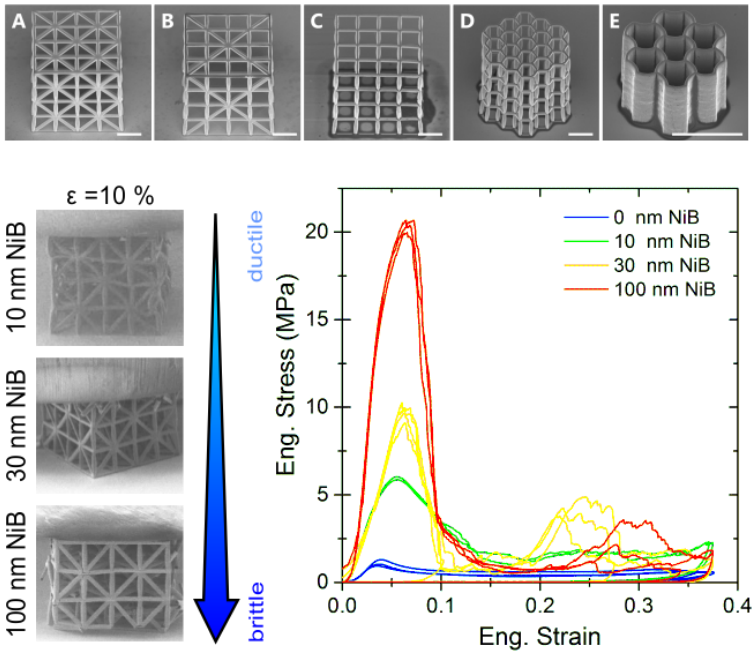

Figure 1 – Stress-strain curves for micro-architecture A as a function of the NiB layer thickness. SEM images showing evidence of ductile-to-brittle transition. Scale bars: 10 µm.