INTERFACE STRENGTH AND TOUGHNESS MEASUREMENTS IN MULTILAYERED SYSTEMS

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Over the last years, miniaturization caused increasingly complex thin film combinations and geometries. Since macro scale tests are not suitable, small-scale experiments are suggested to study the materials response in current and future devices at small length scales. Here, focus is placed on the local determination of interface strength and toughness in layered thin films, also accounting for the presence of residual stresses.

The investigated materials were sputter deposited Cu-W-Cu and W-Cu-W films with individual layer thicknesses of 500 nm on a Si(100) substrate [1]. Different geometries such as notched bending beams, double cantilever beams, and miniaturized shear specimens were fabricated via cross-section polishing and focused ion beam (FIB) milling to quantitatively test individual interfaces. A schematic representation of the involved test setups is shown in Figure 1. Subsequently, miniaturized fracture experiments parallel [2] and perpendicular [3] to the interfaces were performed in-situ in the SEM to obtain comprehensive knowledge of the fracture and interface toughness. Complementary, nanoindentation induced buckles were analyzed.

We emphasize the importance of elastic and plastic incompatibilities, as well as residual stresses when addressing fracture mechanical quantities in layered systems and discuss challenges and prospects of the different approaches.

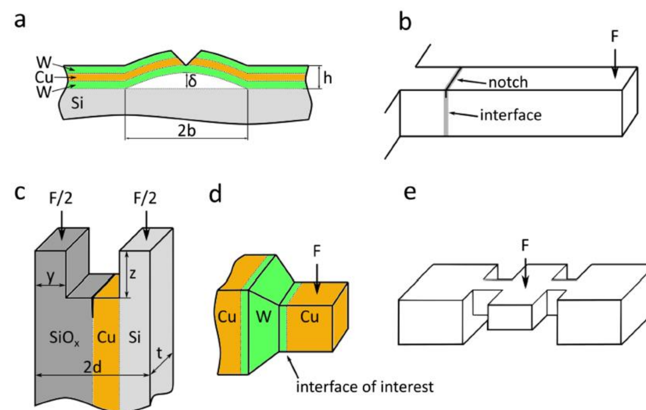

Figure 1 – Schematics of the employed miniaturized testing geometries [2].

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