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Abstract:

The effect of residual inorganic elements on the local plastic deformation behaviour of two different copper films was investigated. It was found that a film containing inorganic elements in the ppm range, has a distinctively higher hardness at twin boundaries and high angle grain boundaries compared to the grain interior. An almost pure copper film shows no distinct difference regarding the plastic deformation compared to the same microstructural features. The results suggest that such residual elements form hard boundaries, leading to higher hardness on a local microstructural level. Moreover, the influence of the local topography was demonstrated. The use of atomic force microscopy before and after indentation illustrated that significant errors in the determination of hardness occurs when the local surface topography matches the dimensions of the indenter tip. This was further confirmed by the quantitative comparison of the elastic properties of the loading and unloading segments of the corresponding load-depth curves using Hertzian contact mechanics and the Oliver-Pharr method. It is demonstrated that the measured hardness values can be directly correlated to local microstructural and topography features.