Fracture behavior of metal-ceramic and metal-metal nanolaminates

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Nanoscale multilayers or nanolaminates are nanostructured materials made up by alternating layers of two or more materials with a layer thickness below ~100 nm. These nanolaminates present very high strengths at ambient temperature. Their unique properties, typically measured by nanoindentation and/or micropillar compression are mainly a result of the high density of interfaces, which change the standard mechanisms of deformation when the layer thicknesses are below ~100 nm. The combination of dissimilar materials together with the small dimensions of the layers are also expected to significantly affect the fracture behavior. However, fracture properties have not been studied in detail so far, mainly due to the lack of appropriate testing techniques to determine fracture toughness at small scales. With the current development of novel nanomechanical testing techniques, it is now possible to test these materials under tension and/or bending, and to determine the fracture behavior of these heterogenous materials Examples will be shown in three different nanoscale multilayer systems, combining metallic and ceramic layers: Cu/Nb and Al/SiC.

Short bio: Dr. Jon Molina-Aldareguia (PhD, Cambridge University, UK) is Senior Researcher and Leader of the Micro and Nanomechanics group at IMDEA Materials Institute. His research interests lay on the mechanical characterization at the micro and nano-scale of a range of advanced engineering materials, from metallic alloys to high performance composites, with the aim of understanding deformation behavior, developing high throughput characterization techniques and informing microstructurally based multiscale material models. Before joining IMDEA Materials Institute, he held research positions at Linköping University, Sweden and CEIT, Spain. He has been Visiting Researcher at INTEL Co. and Arizona State University (USA), as Fulbright Scholar. He has published over 150 papers in his research area and has been the recipient of several awards, like the JOM best paper award and the Excellence in Research award of Carlos III University, where he is adjunct professor.