EFFECTS OF INDENTER GEOMETRY ON MICRO-SCALE FRACTURE TOUGHNESS MEASUREMENT BY PILLAR SPLITTING

Marco Sebastiani, Roma Tre" University, Engineering Department, Via della Vasca Navale 79, Rome, Italy
seba@uniroma3.it
Matteo Ghidelli, Roma Tre" University, Engineering Department, Via della Vasca Navale 79, Rome, Italy
Kurt E. Johanns, Nanomechanics Inc., 105 Meco Ln, Oak Ridge, TN, 37830, USA
George M. Pharr, Texas A&M University, Department of Materials Science & Engineering

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In this presentation, we will show the improvements to a recently developed pillar splitting technique that can be used to characterize the fracture toughness of materials at the micrometer scale. Micro-pillars with different aspect ratios were milled from bulk Si (100) and TiN and CrN thin films, and pillar splitting tests were carried out using four different triangular pyramidal indenters with centerline-to-face angles varying from 35.3° to 65.3°. Cohesive zone finite element modelling (CZ-FEM) was to evaluate the effect of different material parameters and indenter geometries on the splitting behavior. Pillar splitting experiments revealed a linear relationship between the splitting load and the indenter angle, while CZ-FEM simulations provided the dimensionless coefficients needed to estimate the fracture toughness from the splitting load. The results provide novel insights into the fracture toughness of small-scale materials using the pillar spitting technique and provide a simple and reliable way to measure fracture toughness over a broad range of material properties.

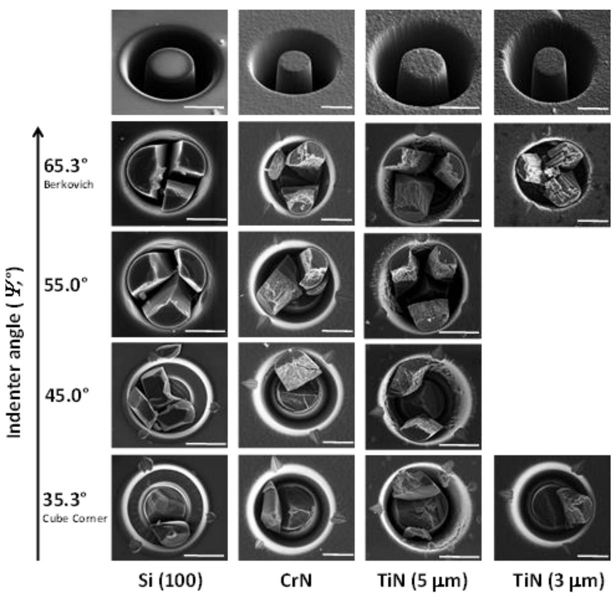

Figure 1a – Effects of the indenter geometry on pillar splitting. The upper row shows the geometry before splitting. The scale bars for Si and TiN are 5 µm, while for CrN and TiN they are 3 µm

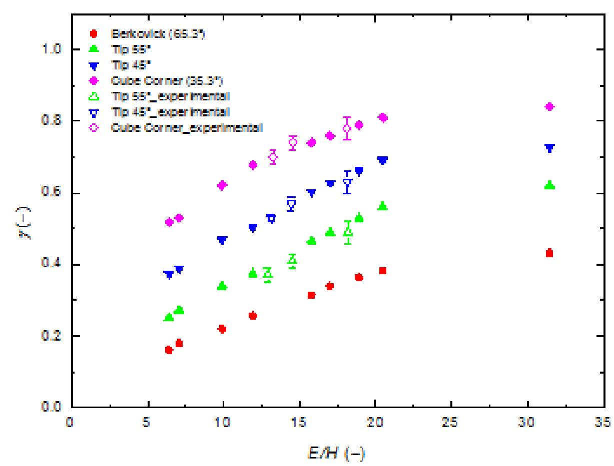

Figure 1b – CZ-FEM gamma coefficient vs E/H for different tip geometries. The full and empty symbols represent, respectively, the FEM simulations and the experimental data..