4A.1_ Mechanism of Soft and Hard Breakdown in Hexagonal Boron Nitride 2D Dielectrics by A. Ranjan, N. Raghavan, S.J. O'Shea, S. Mei, M. Bosman, K. Shubhakar, and K. L. Pey, Singapore University of Technology and Design and A*STAR

In this work, authors investigate the physical mechanism of soft and hard breakdown using conductive atomic force microscope (CAFM) as a nanoscale spectroscopy tool on blanket hexagonal boron nitride (h-BN) films. The soft breakdown regime involves percolation path formation with boron vacancies while the hard breakdown regime shows *nano-pitting* that involves removal of h-BN layers and formation of a metallic contact (filament) due to CAFM tip adhesion with the Cu substrate. The physical mechanisms of breakdown in h-BN have not been studied in-depth in the past and this study presents several evidences to understand these phenomena better. The results would also help in probing the similarities and differences in the dielectric breakdown trend for 2D and 3D (bulk) dielectric films such as HfO2 and SiO2. Authors used the adhesion measurement traces after soft and hard breakdown to prove that the mechanisms involved are very different in these two regimes, as shown in the figure below.