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Thermodynamic Work of Adhesion measurements of Polymer Bonded eXplosive constituents via the Wilhelmy Plate technique and their application to Atomic Force Microscope pull-off experiments DAVID WILLIAMSON, NEIL HAMILTON, STEWART PALMER, ANDREW JARDINE, University of Cambridge, CLAIRE LEPPARD, AWE — There is much evidence that the major strength limiting factor for Polymer Bonded eXplosives above their glass-transition conditions is the magnitude of adhesion that exists between the polymeric matrix binder-system and the filler particles. Experimental measurements of the free surface energies of a number of binders have been made using the Wilhelmy Plate Technique. These data can be combined with equivalent data on the filler particles to calculate the so-called Thermodynamic Work of Adhesion that exits between the matrix and filler particles. This under-pinning quantity can be used to predict the levels of load (stress) required cause debonding in different geometries. A simple geometry of interest is that of spherical-caps of polymers debonding from flat substrates. Experiments using this geometry have been performed with an Atomic Force Microscope pull-off technique to measure the critical loads (stresses) required for debonding. There is good agreement between the predicted values based on the Wilhelmy Plate data, and the measured values from the Atomic Force Microscope. Such understanding and experimental data are required for the development and validation of microstructural models for predicting mechanical behaviour over the whole life cycle.

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