Contact charging and triboelectric separation

The charging of objects by contact or friction, or “triboelectrification”, is one of the most ubiquitous electrical phenomena, and has been studied systematically for at least 2500 years. Despite this, and the simplicity of the basic charging mechanism, triboelectrification of solid materials is still not well-understood in a predictive sense. The reasons for this are complex, and include surface variability, the complicated nature of solid-to-solid contact, and charge back-flow mechanisms. Surprisingly, we do not even understand definitively why sliding or rubbed contact tends to transfer more charge than simple normal contact, although a variety of contributing factors have been identified. We outline some of these factors, and then describe our experimental and theoretical work on triboelectrification of solids, particularly the charging of particulate materials. A good physical understanding of triboelectrification is essential for dry particle processing systems. It can cause unwanted adhesion, agglomeration or dispersion of powders, or can be used to control and exploit these behaviours, as in the handling of photocopier toner particles. Discharges from triboelectric charge build-up can also cause an explosion hazard in particulate systems. An increasingly important application of triboelectrification is in the separation of mixed particulates, particularly in the plastics recycling and minerals industries, and some of our research into triboelectric separation is described.