P.34 Large-area patterning of the tackiness of a colloidal nanocomposite adhesive by sintering of nanoparticles under IR radiation

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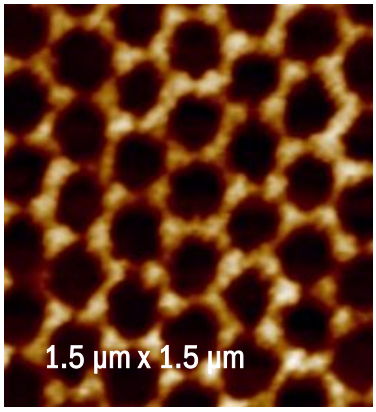
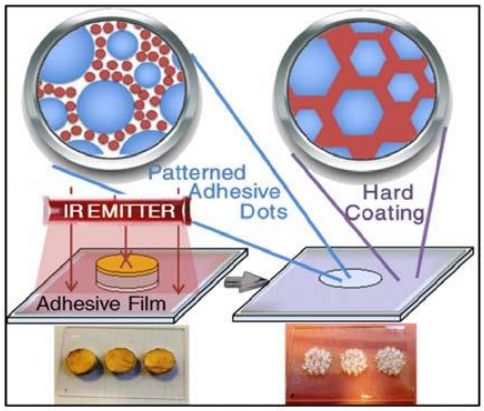
Pressure-sensitive adhesives (PSAs) adhere instantly and firmly to a substrate upon the application of a light pressure. PSAs require the right balance of elastic and viscous properties.[1] A high adhesion energy results not only from the thermodynamic work of adhesion at an interface with a substrate, but also from the bulk mechanical properties, including the large-strain deformation behaviour.[2] With increased emphasis on recycling and re-use of materials, there is interest in adhesives that de-bond or "switch off" on demand, when triggered by an external stimulus. There is a growing need for adhesives that are patterned such that only a portion of their surface is tacky. For instance, electronic components must be attached at specified positions on a PCB, on which electrically conductive adhesives replace metallic solders.

We present a simple technique to switch off the tack adhesion in selected areas of a waterborne colloidal nanocomposite adhesive layer.[3,4] Blends of glassy polymer nanoparticles and larger, soft colloidal particles are cast to create a nanostructured film (see figure, on the left). During probe–tack testing, the soft polymer phases yield and enable fibrillation. After heating under IR radiation, the nanoparticles sinter together to make a rigid percolating structure. The storage modulus increases by a factor of five, and the yield point increases nearly by a factor of six, such that yielding and fibrillation do not occur in the probe–tack tests. In regions that are exposed to IR radiation through a mask, such as gold-coated coins (shown here on the right), the nanoparticles sinter together and harden the adhesive, thereby destroying the tack adhesion locally. Adhesive island regions are defined with the surrounding regions being non-tacky. The process enables switching of the adhesive surface at a desired position.[4]





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