The researchers fabricated their molecularly imprinted polymer (MIP) devices by pressing a monolayer of RBCs of a given antigen type onto a thin layer of polyurethane. The polyurethane was pre-deposited on the sensor of a quartz microbalance for use in later measurements. The cured polymer bears the imprint of the cells, and after removal of the cell layer, the MIP retains toroid shapes characteristic of the cells, as seen by atomic force microscopy. Cell adsorption on the MIPs was then measured by monitoring the response of the quartz microbalance electrode beneath the MIPs relative to an electrode under an unimprinted surface. With this technique, the researchers showed that the greatest number of cells was adsorbed onto MIPs that had been imprinted with cells of the same blood type. This selectivity is especially remarkable, they said, in that all blood cells show nearly the same shape and are highly deformable, and the changes in imprint morphology caused by surface structures are extremely subtle. The researchers said that excess hydroxyl groups on the polyurethane substrates interact with the sugars of the antigens on the imprinting cells, creating a template for selective recognition on the molecular scale through increased hydrogen bonding capacity for the appropriate antigen.

KRISTA L. NIECE

Polymer–Silicon Microcantilevers Serve as Ultrasensitive IR Detectors

Medical imaging, weather forecasting, targeting, and reconnaissance are a few of the critical applications for infrared (IR) detectors. With temperature resolution (the smallest measurable temperature difference) of ~10 mK, traditional IR detectors are essentially photon detectors that require cryogenic cooling, which hampers miniaturization and cost reduction. Uncooled IR detectors, based on thermal detection and a bimaterial microcantilever design, have been fabricated in recent years. The microcantilevers bend reversibly because interfacial stresses develop due to a mismatch between the coefficients of thermal expansion (α) of the two materials. The thermal sensitivity (beam deflection per temperature difference) is mostly a function of the difference in α, in addition to geometrical and structure parameters. Heretofore, the best temperature resolution—approaching 10 mK—has been achieved with bimaterial microcantilevers combining silicon and gold as the high-α and low-α components, respectively, but current applications demand better performance. Recently, however, Iowa State University researcher V.V. Tsukruk, Air Force Research Laboratory researcher T.J. Bunning, and their co-researchers have replaced the contemporary metal–silicon bimorphs with a polymer–silicon hybrid design with much larger interfacial thermal stresses, resulting in temperature resolutions approaching 2 mK and thermal sensitivities of ~2 nm/mK, unprecedented values for uncooled detection.

As reported in the April 12 issue of *Nano Letters* (p. 730; DOI: 10.1021/nl0525305), the research team used plasma-enhanced chemical vapor deposition (PECVD) to selectively coat one side of silicon microcantilevers (~300 μm in length, ~30 μm in width, ~0.7 μm thick) commonly used in atomic force microscopy (AFM) with several highly cross-linked plasma polymers. In this publication, polystyrene (PS) is featured, and the PS-layer thicknesses were precisely controlled and confirmed by scanning electron microscopy and ellip-

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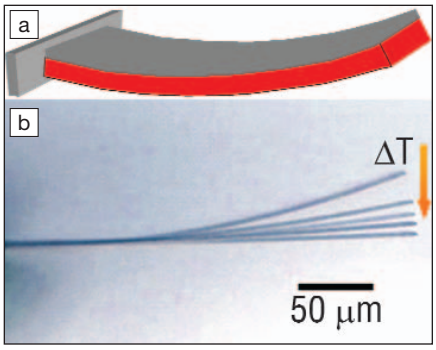

Figure 1. (a) Schematic illustration of a bimaterial cantilever bending with incident heat. (b) Side view of an optical image of a polymer–silicon microcantilever bending as the temperature increases 20–40°C. Reproduced with permission from Nano Letters ***6*** *(4) (April 12, 2006) p. 730; DOI: 10.1021/nl0525305. © 2006 American Chemical Society.*

sometry to be in the range of 20–200 nm. AFM revealed that the PS layer has a smooth, uniform surface morphology and an elastic modulus of nearly 2 GPa. In addition, the PS could not be dissolved in or swollen by organic solvents. Compressive residual stresses arising from PECVD of PS result in a bent and stressed bimorph beam (see Figure 1), whose initial parameters can be controlled by deposition conditions.

The researchers showed that deflections of their microcantilever as a function of temperature within either a narrow temperature range (30–31°C) or a broader range (20–45°C) are many times higher than those of a reference microcantilever composed of silicon with a 60-nm gold layer, which is the common materials platform for uncooled IR bimaterial microsensors. The thermal sensitivity of 1–2 nm/mK is much higher than that displayed by the gold–silicon reference (0.056 nm/mK) or the value achieved by the best uncooled microcantilever IR detectors (0.12 nm/mK) currently on the market. Using a mathematical analysis, the researchers concluded that the intrinsic stress within the PS layer reverses sign and becomes tensile at the elevated temperature at which their microcantilevers attain planarity. In a temperature range of 20–45°C, the overall variability between the first and 100th cycle was <1.5%, and the thermal sensitivity varies only about 1%. The researchers said, "Due to the wide variety of monomers that can be plasma-deposited, our approach allows for further chemical modification to make multifunctional chemical–thermal microsensor arrays with tunable spectral response" and the dry polymer deposition process "is compatible with batch microfabrication processing."

STEVEN TROHALAKI

DNA and Gold Nanoparticles Form 3D Nanoscaffolds

Programmed nanostructures, ordered two- and three-dimensional nanoparticle arrays, nanoelectronics, nanophotonics, biosensing, bioimaging, and biodiagnostics are some of the potential applications for DNA–nanoparticle bioconjugates. DNA's fabrication advantages include its physicochemical stability, mechanical rigidity, specific base-pairing, and predictable intermolecular and intramolecular interactions. In addition, mature enzymatic methods exist for DNA modification as well as for DNA amplification—the production of many DNA copies from one or a few originals. Rolling circle amplification (RCA) is one powerful variation in which a DNA polymerase continuously grows a DNA chain by adding nucleotides according to a circular DNA template. Recently, M.A. Brook, Y. Li, and co-researchers of McMaster University have used RCA to construct unique 3D scaffolds composed of DNA and gold nanoparticles (Au NPs).

As described in the April 3 issue of *Angewandte Chemie International Edition* (p. 2409; DOI: 10.1002/anie.200600061), the researchers used an established method to attach thiol-modified single-stranded (ss) DNA primers, 41 nucleotides in length, to gold nanoparticles, 15 nm in diameter. UV–vis spectroscopy showed that each structure (called primer-Au) had about 230 ssDNA primer strands, on average. A complementary 63-nucleotide circular, ssDNA template was then annealed to the primer-Au with ~30% efficiency. Under conditions that the researchers determined to be optimal, RCA was performed with the DNA polymerase ϕ29DNAP at a relatively low primer-Au concentration (~0.67 nM) for a relatively short time (30 min) to produce structures (termed long-DNA Au) composed of Au NPs with long ssDNA attached (see Figure 1). The researchers used gel electrophoresis, before and after digestion with restriction enzymes, and atomic force microscopy (AFM) to show that RCA produced high-molecular-weight DNA in excess of 1000 nucleotides.

The long-DNA Au structures were then assembled into 3D scaffolds by overnight incubation with 5-nm Au NPs modified with 25-nucleotide complementary oligonucleotides that form Watson–Crick base pairs—that is, double-stranded DNA (dsDNA)—with the long ssDNA (see Figure 1). The resulting complexes were isolated using low-speed centrifugation. Transmission electron microscopy showed that the 5-nm Au NPs reside in the area surrounding the 15-nm Au NPs (see Figure 2). The distance between the 5-nm

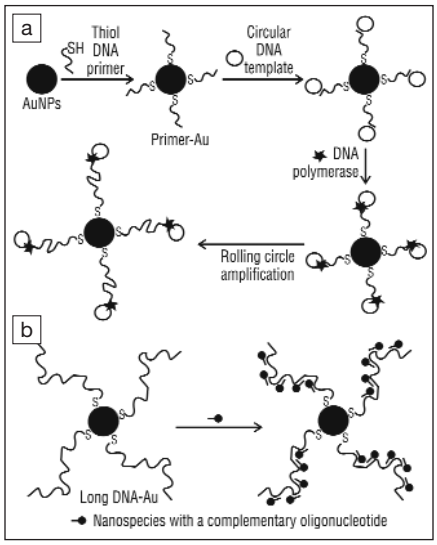

Figure 1. (a) Schematic illustration of rolling circle amplification (RCA) on gold nanoparticles (Au NPs). (b) DNA–Au conjugates produced by RCA as a scaffold for the formation of three-dimensional nanostructures. Reproduced with permission from Angewandte Chemie International Edition ***45*** *(15) (2006), p. 2409; DOI: 10.1002/anie.200600061. © 2006 Wiley-VCH, Weinheim.*

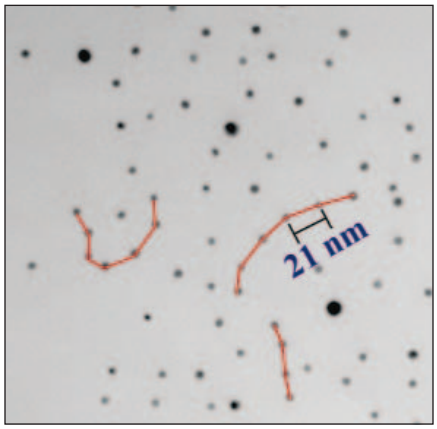

Figure 2. Transmission electron micrograph of nanoassembled superstructures prepared from 5-nm gold nanoparticles modified with antisense DNA and long-DNA Au scaffolds. Reproduced with permission from Angewandte Chemie International Edition ***45*** *(15) (2006), p. 2409; DOI: 10.1002/anie.200600061. © 2006 Wiley-VCH, Weinheim.*

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