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Synthetic Gecko Foot-hairs from Multiwalled Carbon Nanotubes[1]

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The mechanism that allows a gecko lizard to climb any vertical surface and hang from a ceiling with one toe has attracted considerable interest and awe for over two millennia. Recent studies have discovered that the gecko's ability to defy gravity comes from its remarkable feet and toes. Each five-toed foot is covered with microscopic elastic hairs called setae. The ends of these hairs split into spatulas which come in contact with the surface and induce enough intermolecular [van der Waals, (VdW)] forces to hold them in place. Similarly, the same VdW forces act between our two hands when they are held together, but in this case, they do not stick to each other. The reason is that the roughness of our hands prevents them from coming close to each other at separations relevant for VdW forces. On the other hand, based on the gecko's foot anatomy, if our hands were made up of tiny elastic structures that were able to deform or bend at different length scales in accordance with the contact surface and correct for the roughness, then perhaps our hands could also adhere to the surfaces we touch. In my talk, I will present the recent advances we have made in fabricating polymer surfaces with multiwalled carbon nanotube hairs with strong nanometer-level adhesion forces that are 200 times higher than those observed for Gecko foot-hairs. This fabrication process allows the flexibility to create structures that are found in nature on the Gecko's foot and offer excellent potential for applications as dry adhesives for space, microelectronics and MEMS devices. This work was done in collaboration with Betul Yurdumakan, Nachiket Raravikar and Pulickel Ajayan.

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