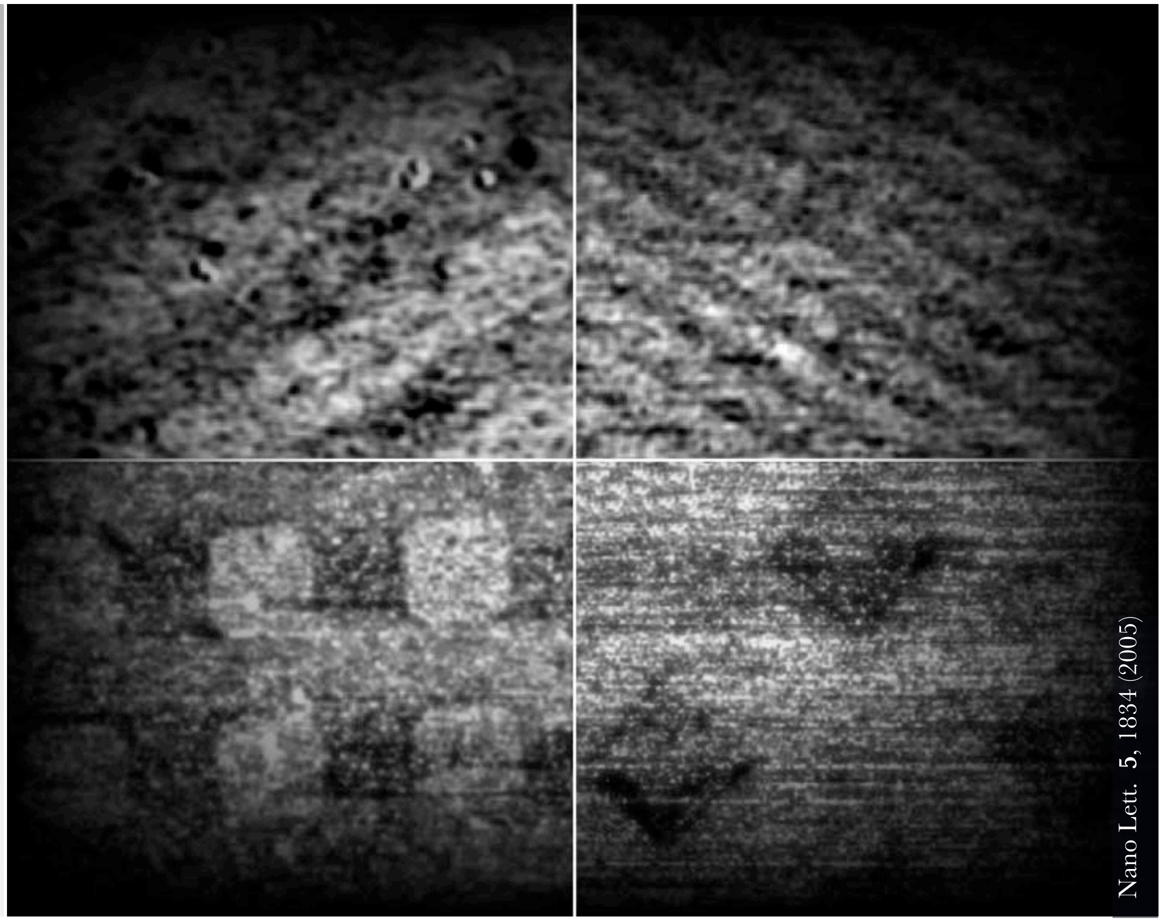
MICRODISPLACEMENT

Penn State MRSEC

Patterns formed when a molecular ink displaces an existing self-assembled monolayer.



Printing patterns with diverse inks
molecular shepherds stop the spread

IRG1

Penn State researchers have designed a new patterning strategy, microdisplacement printing, which can stamp complex chemical patterns onto a substrate without mixing between the different "inks." A self assembled monolayer is a single layer of highly ordered, closely packed molecules sitting atop a surface such as gold. A self-assembled monolayer of 1-adamantane-thiolate, which does not pack so tightly, is vulnerable to displacement by more tightly-packing molecules. In microdisplacement printing, a molecular "ink stamp" is pressed into an adamantane-thiolate monolayer. Everywhere that the stamp touches, the chemical "ink" displaces the adamantanethiolate. Unlike the stamping of inks onto a normal surface, in microdisplacement printing the pre-existing monolayer of adamantanethiolate blocks the spread of the ink.

Using microdisplacement printing, we have patterned not only molecules that are compatible with current microcontact techniques, but also molecules that are too mobile on a surface to be patterned by conventional methods, such as short-chain alkanethiols. This fine degree of control allows us to stamp many different inks in sequence to form complex multi-component patterns- like printing in many colors instead of just black and white. In the future, we may even be able to insert single molecules at specified locations. This work initiated the commercial synthesis of 1-adamantanethiol by Sigma-Aldrich; our continuing relationship with them focuses on making molecules of all sorts for patterning: a new stable of molecular inks.