Multifunctional, "Smart", Polymeric Microfluidics Fabricated by Plasma Processing: Applications in Capillary Filling, and Passive Superhydrophobic Valving

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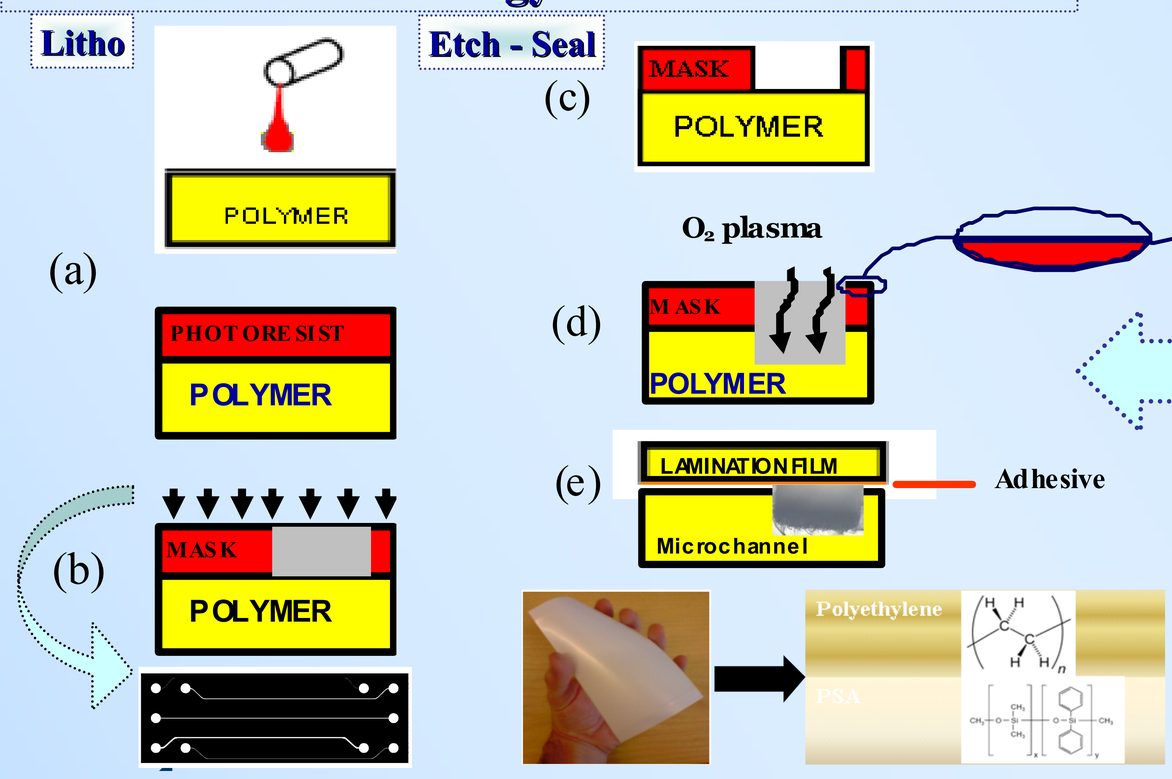
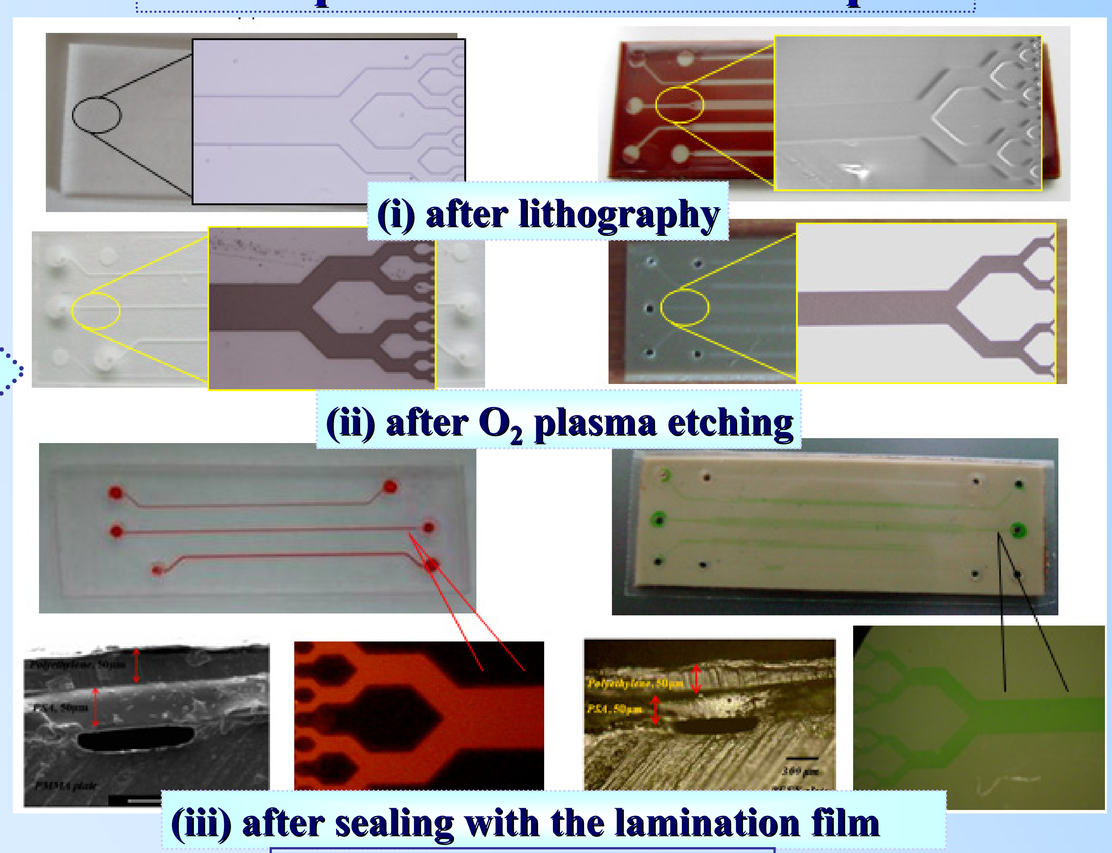
Objective - Goals

- **Propose "smart" multifunctional microfluidics fabricated by a plasma technology toolbox, a planar technology for LOAC**
- **We use (a) direct lithography on the polymer, (b) plasma etching, and (c) plasma deposition for: 1) fabrication, 2) surface area control, 3) wettability control and 4) integration of polymeric microfluidic devices**
- **We use Poly(methyl methacrylate) (PMMA) and Poly(ether ether ketone) (PEEK) substrates or any other polymer**
- **Etch at desired depth. No need for different molds with different etch depths**
- **Absolute control of surface roughness (from smooth to very rough) is demonstrated**
- **In situ modification of wettability**
- **We demonstrate 1) spontaneous capillary pumping through rough, superhydrophilic microchannels**
- **Passive valving through super-hyrdophobic patches inside the microchannels, and use them as passive valves**

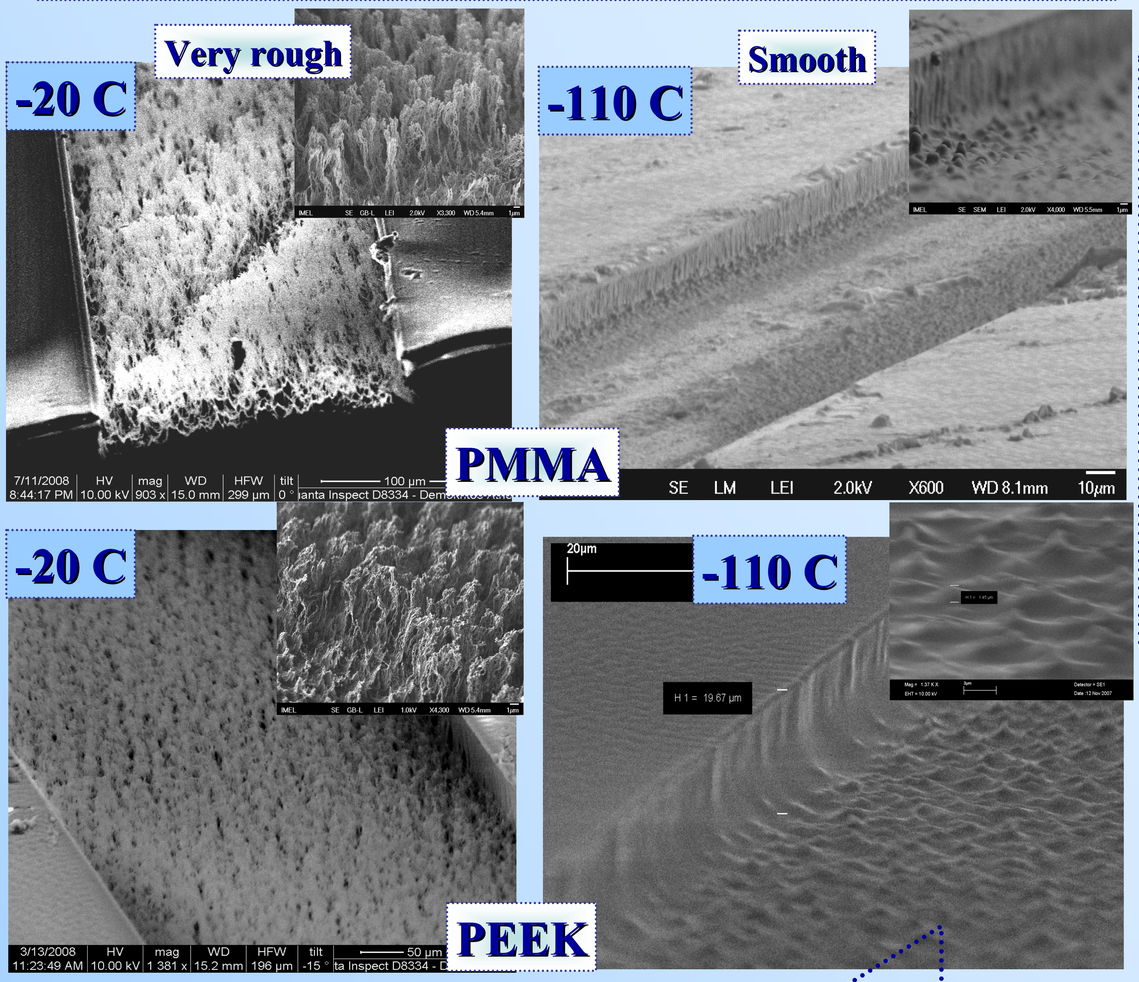
The Planar Technology – Fabrication Process



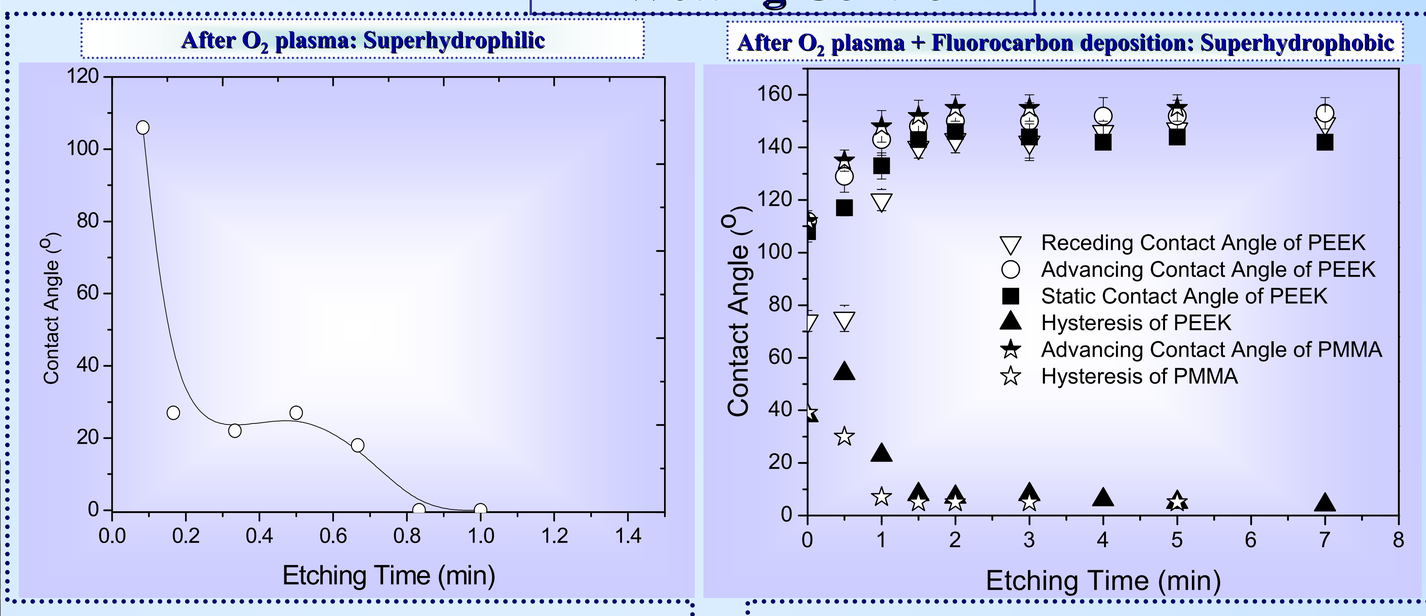
PMMA plates PEEK plates



Control of Microchannel Roughness – Surface area



Wetting Control



Incorporation of both in microchannel

Passive Valving, Featuring Extreme Wetting States in a Single Microchannel

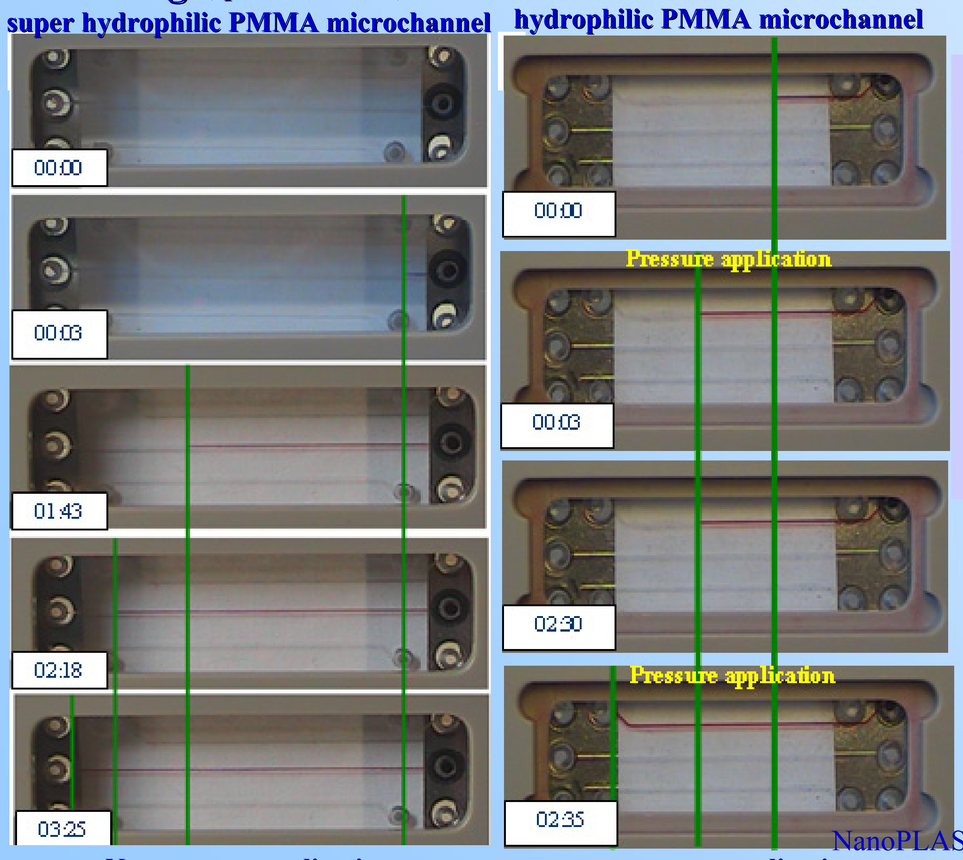
After O_2 plasma etch, do plasma deposition through stencil mask

Stencil mask

Capillary Pumping Stable in Time

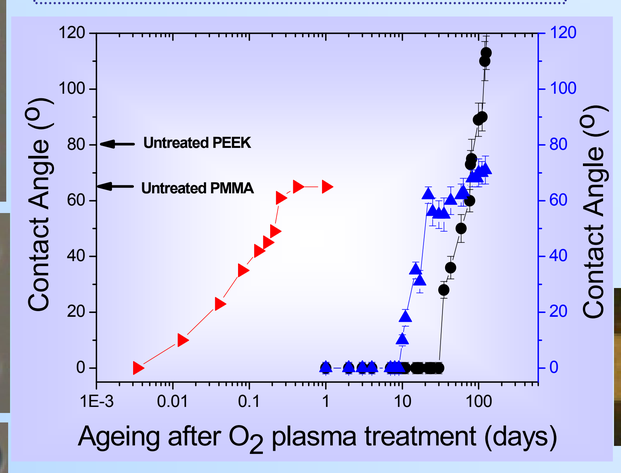
Rough, plasma etched, super hydrophilic PMMA microchannel

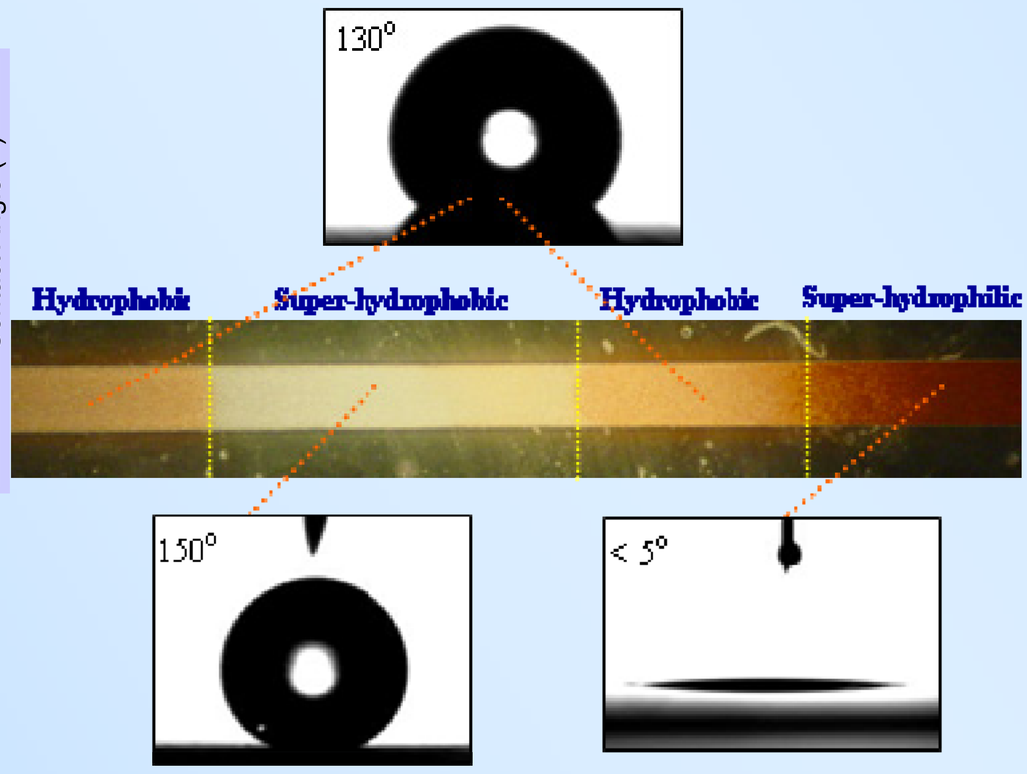
Smooth oxygen plasma activated hydrophilic PMMA microchannel



No pressure application — pressure application

Ageing Resistance: Very Slowly Ageing of Hydrophilicity





Reference:
Tsougeni K.; Papageorgiou, D.; Tserepi, A.; Gogolides, E.
***Lab Chip*, 2010, 10, 462.**

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