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Comparison of the Compliance and Deformation Properties of PDMS and NOA Microfluidic Chips

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Extended Abstract

Microfluidic devices are often made from polydimethylsiloxane (PDMS) due to its low cost, transparency, and simplicity. However, high-pressure flow through PDMS microfluidic channels leads to an increase in channel size due to the compliance of the material. As a result, longer response times are required to reach steady flow rates, which increases the overall time required to complete experiments when using a syringe pump. Due to its excellent optical properties and increased rigidity, Norland Optical Adhesive (NOA) has been proposed as a promising material candidate for microfluidic fabrication. This study compares the compliance and deformation properties of PDMS and NOA microfluidic chips, including their Young's modulus, roughness, compliance, and chip deformation. The Young modulus for the PDMS and NOA was found using the Instron machine under tensile strength. The surface roughness for both materials was found using the Dektak XT profilometer. The compliance of the microfluidics chips is compared through the measurement of the characteristic time required for channels to achieve an output flow rate equivalent to that of the input flow rate using a syringe pump and the Fluigent S flow meter. The characteristic time of the system is extracted by fitting the data to a model derived originally from the Windkessel model. The chip deformation is found by measuring the channels width under the microscope for the PDMS and NOA chips.

With the tensile strength test, the Young modulus is 2 MPa for the PDMS and 1743 MPa for the NOA 63. The surface roughness was found to be higher for the NOA than for the PDMS. Preliminary results show a reduction of time delay of 50% when using NOA chip for large channel. Therefore, the compliance is smaller for the NOA devices than the PDMS devices.