

Preparation of nanopore-confined sample

Polymer: poly(phenylmethyl siloxane) with molecular weights $M_w = 2530$ g/mol and polydispersity index of 1.4 (labeled as PMPS 2.5k).

AAO nanopores: anodized aluminum oxide (AAO) membranes (pore diameter of 20 nm, 60 nm, 100 nm, and 200 nm, the pore depth was 100 μ m) purchased from Inredox (USA).

Pore filling procedure: The membranes were first dried at 473 K under vacuum for 24 hours to remove all volatile impurities from the nanopores. Afterward, they were used for confining the viscous polymer. A thin film of PMPS 2.5k was placed on top of each AAO membrane, and infiltration was carried out at 313 K under vacuum for two weeks to ensure that the material flowed into the nanopores through capillary forces. Following the filling process, the membranes were carefully dried with a delicate dust-free tissue. The membranes were weighed before and after infiltration, and the filling procedure was considered complete when the mass of the confined polymer remained constant over time. Based on the membrane porosity, the density of the material, and the mass of the membrane before and after infiltration, the filling degree was estimated to vary between 85% and 98%

Table 1 . Mass of AAO nanopores before, during and after filtration.

Pore diameter [nm]	Mas of empty membrane [mg]	Mas after 1 week of infiltration [mg]	Mas after infiltration [mg]
20	30,78	32,62	32,62
60	31,64	33,51	33,52
100	31,56	33,22	33,22
200	32,21	34,05	34,05