Hydrogen silsesquioxane mold coatings for improved replication of nanopatterns by injection molding - DTU Orbit (10/12/2018)

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We demonstrate the replication of nanosized pillars in polymer (cyclic olefin copolymer) by injection molding using nanostructured thermally cured hydrogen silsesquioxane (HSQ) ceramic coatings on stainless steel mold inserts with mold nanostructures produced by a simple embossing process. At isothermal mold conditions, the average pillar height increases by up to 100% and a more uniform height distribution is observed compared to a traditional metal mold insert. Thermal heat transfer simulations predict that the HSQ film retards the cooling of the polymer melt during the initial stages of replication, thus allowing more time to fill the nanoscale cavities compared to standard metal molds. A monolayer of a fluorinated silane (heptadecafluorotrichlorosilane) deposited on the mold surface reduces the mold/polymer interfacial energy to support demolding of the polymer replica. The mechanical stability of thermally cured HSQ makes it a promising material for nanopattern replication on an industrial scale without the need for slow and energy intensive variotherm processes.

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