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Towards experimental detection of crystallization in individualized polymer chains

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Although crystallization of polymers has been investigated since decades, it is not yet fully understood. One way to gain more insight is to study the difference between bulk polymer and confined polymer chains with focus on how crystallization characteristics change depending on the size and type of confinement. Until now, most studies have used confinement in thin films or nanopores but the approach to study crystallization and aggregation in individual chains was accessible only to computer simulations.

Since detection of phase transitions in individual polymer chains poses a severe challenge to most experimental methods, the measurement of ensembles of individual chains is desirable. However, maintaining the individual character requires a sophisticated method to separate them. Here, we use block copolymer micelle lithography (BCML) to deposit a regular pattern of well-separated gold nanodots on a silicon substrate in order to chemically graft end-functionalized polymer chains on these nanodots to individualize them. Instead of common thermodynamic methods (which require considerably more sample material), we employ dielectric spectroscopy using a nanostructured electrode arrangement since it is much more sensitive. Albeit being typically considered a dynamics method, it also allows to examine density changes and thus phase transitions of polymers.

Category

Solid State (Experiment)

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