Polymer Particle Platforms in Modern Biomedicine

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Abstract:

Polymer particles are attracting growing attention because of their versatile applications in diagnostics and therapy. Here, we present a novel approach for fabricating such particles by controlled melting of a thin polymer film deposited on a solid substrate. The procedure comprises spin-coating a polymer film onto a planar surface, followed by immersion the coated sample in a polar solvent and heating it above the polymer's melting temperature. Under this conditions, dewetting occurs, resulting in producing droplets of molten polymer, which solidify upon cooling.

These particles can be functionalized with organic molecules e.g. doxorubicin – an anthracycline anticancer drug. Encapsulating doxorubicin enables localized release, so that lower systemic toxicity can be obtained.

Structure and properties were comprehensively characterized using complementary physicochemical techniques, including optical microscopy, scanning electron microscopy (SEM), and Raman spectroscopy. These analyses guided the optimization of polymer composition and concentration.

The fabricated particle arrays underwent evaluation, to confirm their suitability as platforms for biomedical applications. Therapeutic potential was assessed in vitro using triple-negative breast cancer cells (MDA-MB-231). Substrates with drug-loaded polymer particles reduced the viability of cancer cells. Collectively, the results highlight the considerable promise of this method for designing multifunctional platforms for biomedical applications.