DESIGNING THERMORESPONSIVE POLY(N-ISOPROPYLACRYLAMIDE) COPOLYMERS FOR BIOMEDICINE VIA ONE-POT MICROWAVE-ASSISTED SYNTHESIS

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Poly(N-isopropylacrylamide) (PNIPAM) is a thermoresponsive polymer widely studied for its lower critical solution temperature (LCST) of 32°C, making it suitable biomedical applications. The aim of this work is to synthesize PNIPAM-based copolymers with an adjusted LCST of 37°C, ideal for biomedical applications, through an innovative one-pot microwave-assisted polymerization process. Copolymers were synthesized using comonomers such as methyl methacrylate (MMA), acrylic acid (AAc), acrylamide (AAm), maleic anhydride (MA), and styrene (St), with comonomer concentrations ranged from 5 wt% to 20 wt%. Structural, thermal and mechanical characterization of the obtained copolymers was carried out using Fourier-transform infrared spectroscopy (FTIR), differential scanning calorimetry (DSC) and dynamic-mechanical analysis (DMA). Results showed significant LCST tunability based on comonomer type and concentration. Copolymers with MMA displayed stable LCSTs at $\sim$33°C across all concentrations. AAc-based copolymers, as well as MA-based copolymers, achieved LCSTs of 34–35°C, while Aam-based copolymers demonstrated precise control, with LCSTs ranging from 36°C (5 wt% AAm) to 39°C (10 wt% AAm), achieving the desired 37°C with the addition of 6 wt% AAm. Conversely, copolymers with St exhibited a substantial decrease in LCST to 21°C, reflecting the hydrophobic influence of styrene. FTIR confirmed successful copolymerization, while DSC and DMA analyses provided insights into thermal transitions and mechanical properties, respectively. This study highlights the potential of microwave synthesis in tailoring PNIPAM-based thermosensitive films for biomedicine via copolymerization, with precise LCST adjustments enabling advanced applications in wound dressing and drug delivery.

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