Photoactive interpenetrating polymer network as intelligent drug delivery system fabricated by super critical carbon dioxide technology

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The release of drugs/therapeutic factors from an appropriate dosage form and suitable time intervals, represents a main challenge for scientists involved in tissue engineering and pharmaceutical studies. To address this issue, drug delivery systems based on stimuli responsive scaffolds have received growing attention. For the triggered release, these so-called smart drug delivery systems are designed to react on certain internal or external stimuli like pH, enzymes, temperature and light. Among these different forms of inputs, light has numerous advantages including that it can be delivered with high spatial and temporal precision with no chemical contaminants.

In recent years, interpenetrating polymer networks (IPNs) is considered as innovative biomaterials for drug delivery, due to strong entrapment of drug molecules between the polymeric chains of networks and desired properties that could be achieved by tailoring the type of polymers and their concentrations. In order to generate IPN, the impregnation of the host network by second one could be applied via supercritical carbon dioxide ($scCO_2$) due to its superb merits, *e.g.* being nontoxic, economical, nonflammable, widely available, eco-friendly, and having unique solvating properties.

In this study, by incorporating photoactive moieties (spiropyran-based polymers) into the IPN structure, the intelligent light-sensitive IPN with supercritical carbon dioxide ($scCO_2$) was synthesized. In this system, spiropyrans undergo reversible isomerisation from the hydrophobic (neutral) spiropyrane state to the hydrophilic (zwitterionic) merocyanine state under specific light-irradiation conditions which cause the swelling and release of drug. This smart, photoactive construct could be a promising candidate as intelligent light-triggered drug delivery scaffold which can control the time and place of release of a therapeutic agent to achieve a higher local concentration, reduce overall injected dose and systemic toxicity.