Cyclodextrin Stabilised Emulsions, Cyclodextrinosomes and Cyborg Cells

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We explored the self-assembly of cyclodextrins (CDs) at the oil-water interface through the formation of inclusion complexes (ICs) with the oil and further assemble into microcrystals at the oil-water interface [1-4]. We demonstrate the spontaneous formation of a dense layer of adsorbed CD-tetradecane IC microcrystals at the tetradecane-water interface whose morphology and size are dependent on the type of CD and oil used. At large oil volume fractions, this phenomenon led to the formation of a Pickering type of oil-in-water emulsion stabilised by adsorbed CD-oil microcrystals while at low oil volume fractions it completely solubilises the oil in the form of IC microcrystals. We also report the preparation of o/w emulsions stabilised by microcrystals of cyclodextrin-oil inclusion complexes. The inclusion complexes are formed by threading cyclodextrins from the aqueous phase on n-tetradecane or silicone oil molecules from the emulsion drop surface which grow further into microrods and micro-platelets depending on the type of cyclodextrin. These microcrystals remain attached at the surface of the emulsion drops and form densely packed layers. The novelty in this emulsion stabilisation mechanism is that molecularly dissolved cyclodextrin from the continuous aqueous phase is assembled into colloid particles directly onto the emulsion drop surface, i.e. molecular adsorption leads to effective Pickering stabilisation. The β-CD stabilised tetradecane-in-water emulsions were so stable that we used them as templates for preparation of cyclodextrinosomes after the removal of the core oil (Fig. 1). We also report the preparation of CD-stabilized emulsions with a range of other oils and studied the effect of the salt concentration in the aqueous phase, the type of CD and the oil volume fraction on the type of emulsion formed. The CD-stabilized emulsions and cyclodextrinosomes can find applications in a range of surfactant-free formulations in cosmetics, home and personal care, and in pharmaceutical formulations as drug delivery vehicles. We describe two alternative methods for surface functionalisation of living cells with cyclodextrin molecules without affecting the cell viability [5] (Fig. 1). Living cells functionalised with CDs may find many potential applications as they can be loaded with drugs, immunosuppressants and other molecules forming inclusion complexes with their cyclodextrin interface.

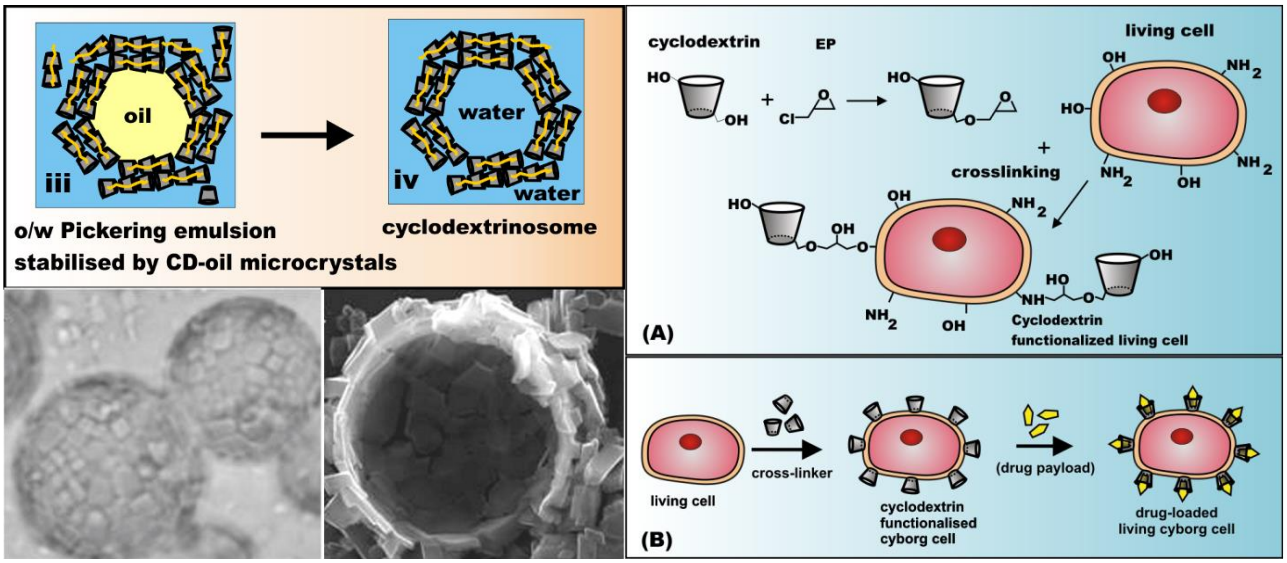

Fig. 1. LHS: Formation of cyclodextrinosomes from cylodextrin-stabilised o/w Pickering emulsion droplets. RHS: (A) Funcrionalisation of living cells with cyclodextrins. (B) Loading of functionalised cells with actives.

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