Micro/nanofabricated Platforms for Oral Drug Delivery

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Abbreviations: BCS, Biopharmaceutics Classification System; ConA, concanavalin A; GI, gastrointestinal; IBD, inflammatory bowel disease; IBS, irritable bowel syndrome; MEMS, microelectromechanical systems; MIMIC, micromolding in capillaries; MIPs, molecularly imprinted polymers; NEMPs, nanoengineered microparticles; PCL, polycaprolactone; PDMS, polydimethylsiloxane; PEDOT, poly(3,4-ethylenedioxythiophene); PEG, poly(ethylene glycol); PEGDMA, poly(ethylene glycol) dimethacrylate; PEGMA, poly(ethylene glycol) methacrylate; PHEMA, poly(hydroxyethyl methacrylate); PLGA, poly (lactic-co-glycolic acid); PMAA, poly(methacrylic acid); PMMA, poly(methyl methacrylate); PVP, poly(vinyl pyrolidone); TEER, transepithelial electrical resistance.

Abstract

The oral route of drug administration is most preferred due to its ease of use, low cost, and high patient compliance. However, the oral uptake of many small molecule drugs and biotherapeutics is limited by various physiological barriers, and, as a result, drugs suffer from issues with low solubility, low permeability, and degradation following oral administration. The flexibility of micro- and nanofabrication techniques has been used to create drug delivery platforms designed to address these barriers to oral drug uptake. Specifically, micro/nanofabricated devices have been designed with planar, asymmetric geometries to promote device adhesion and unidirectional drug release toward epithelial tissue, thereby prolonging drug exposure and increasing drug permeation. Furthermore, surface functionalization, nanotopography, responsive drug release, motion-based responses, and permeation enhancers have been incorporated into such platforms to further enhance drug uptake. This review will outline the application of micro/nanotechnology to specifically address the physiological barriers to oral drug delivery and highlight technologies that may be incorporated into these oral drug delivery systems to further enhance drug uptake.

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