Spatial Arrangements of Organic Positions Due to Thin Film Nanosmearing Under Shear Environment

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Abstract

The objective of the study was to investigate the surface chemistry of powder particles related to their adhesion forces due to the formation of nanosmeared thin layers under the shear environment. Influence of blend composition and mixing order on thin film nanosmearing on particle surface was studied as a function of powder and tablet properties. Multiple pharmaceutical blends containing avicel 200 and micronized acetaminophen were prepared at three different mixing orders (M.O) of magnesium stearate (MS) and colloidal silica (CS) (M.O-1: MS added first, M.O-2: CS added first and M.O-3: MS and CS added together) at a shear rate of 80 rpm and a shear strain of 640 rev. Chemical analysis such as inductively coupled plasma mass spectroscopy (ICPMS), scanning electron microscopy with X-ray microanalysis/energy dispersive spectroscopy (SEM/EDS), x-ray diffraction and hydrophobicity was done for powder samples collected before and after subjecting to shear. Powder samples were compressed into tablets and their hardness and dissolution characteristics as a function of density and force were studied. Experimental techniques were developed to interpret the general aspects of local electron density based on percentage area distribution obtained from EDS mapping. Hydrophobicity that was sensitive to blend composition increased with shear and was found to be inversely proportional to the drug release rate of tablets. Changes in surface characteristics due to mixing order and smearing of flowing agents in heterogeneous systems were found to alter the primary function of components in the powder blend. The results of chemical analysis clearly showed that different mixing orders of components altered the relative surface parameters resulting in different electronic patterns and microscopic structures of particle surfaces. Interestingly, changes in the structural geometries due to nanosmeared layers were found to also influence the tablet dissolution. One of the practical implications of this study is that the nanosmearing due to shear environment and mixing order appear to be the key factor that is affecting the drug release rate.

keywords: nanosmearing; drug release; dissolution; tablet; powder; hydrophobicity; electron density; mixing order; shear.

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