Investigating Dispersibility of Carbamazepine in Solid Solution by Raman Chemical Imaging Technique

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Abstract
Raman Chemical Imaging is a fast, highly selective and sensitive technique and was used to study the interactions of carbamazepine (CBZ) with Soluplus® in solid solutions prepared by hot melt-extrusion and solvent casting.

Keywords
Soluplus, Raman Chemical Imaging, solid solutions/dispersions

Introduction
Raman spectroscopy, a laser-based inelastic scattering technique, has been used for investigating the interactions of drugs and their interactions in complex systems. Raman Chemical Imaging (RCI) couples the specificity of Raman spectroscopy with spatial resolution of optical microscopy. RCI technique provides a “chemical fingerprint” of a pharmaceutical compound, which makes it a powerful analytical tool to study molecular interactions and to understand drug interactions with polymeric matrices.

Materials and Methods
Soluplus and Carbamazepine were obtained from BASF Corporation (Florham Park, NJ). Hot melt extrusion was carried out on a Thermo Fisher Polylab PTW using 16 mm twin screws and operated at a speed rate of 200 rpm and feed rate of 2 kg/h. Physical mixtures and solid solutions were studied by X-ray Diffraction using a Rigaku Ultima IV system with a Cu Kα radiation. RCI studies were performed at 20x and 100x magnification, and the data was analyzed using CI Xpert 2.5 software (ChemImage Corporation, Pittsburg, PA).

Results and Discussion
Solvent cast physical mixtures containing 15 wt% of CBZ in Soluplus were characterized by X-ray diffraction (XRD) and compared with the solvent casted CBZ at 30 wt% and 50 wt%. Figure 3 shows the X-ray diffraction patterns of the samples investigated. The XRD analysis of extrudates with 30 wt% Soluplus and 15 wt% CBZ showed no crystalline peaks and Soluplus remained amorphous. The x-ray diffraction patterns of the samples investigated. The XRD analyses of extrudates with 15 wt% Soluplus and 30 wt% CBZ showed no crystalline peaks and CBZ remained amorphous. This data suggests that CBZ showed partial miscibility at 30 wt%, and complete immiscibility at 50 wt% in the polymer in the extrudates, a mechanism for understanding drug interactions with polymeric matrices.

Conclusion
The data shows complete dispersibility of crystalline CBZ into an amorphous state as observed by Raman shifts in the CH stretching regions and confirmed by X-ray diffraction in 15/85 w/w extrudates and solid solutions from casted films containing CBZ at 25%. Raman Chemical Imaging was able to detect the presence of both CBZ polymorphs in the spiked samples, and was able to detect CBZ polymorphs in the spiked samples. RCI remains a powerful tool to study the interactions of APIs in polymers at a spatial resolution of ~0.5 μm.