



## IFPRI BRIEF TEMPLATE

Check One:  Project  Review  Collaboration  
 Workshop  Other

<b>Descriptive Title</b>	Phenomenological Review on Surface Property Characterization of the Relaxation of Dry Milled Materials
<b>Working Title<sup>1</sup></b>	Phenomenological Review on Surface Property Characterization of the Relaxation of Dry Milled Materials
<b>Technical Area<sup>2</sup></b>	Size reduction, characterization
<b>Date</b>	13 JUN 2023
<b>Short Description</b>	<p>Dry milling of materials often results in surface structural disorder / amorphicity and/or changes in surface chemistry. These effects are often transient and materials show relaxation behavior over time, leading to changes in apparent particle size distribution, drifting SSA, changes in cohesion and the ultimate behavior downstream. The heterogeneity in terms of surface characteristics at varying length scales can also have an influence on this behavior.</p> <p>The aim of this review is to survey the existing scientific landscape to establish our current understanding of the matter.</p>
<b>Objectives</b>	<ul style="list-style-type: none"> <li>· Develop fundamental understanding of relaxation phenomena</li> <li>· Identify the surface characterization techniques that are used to probe the physicochemical properties as they vary with different length scales</li> <li>· Evaluate the cutting edge and emerging tools that will be relevant in the future</li> </ul>
<b>Scope</b>	<p><b>Fundamental understanding of relaxation phenomena:</b> including but not limited to the changes in crystallinity, particle size distribution, specific surface area, surface energy, triboelectrification, cohesion/adhesion, etc.</p> <p><b>Identify the surface characterization techniques used to probe physicochemical properties:</b> including but not limited to spectroscopy, nanoparticle characterization, imaging, microscopy, surface probe microscopy, etc.</p>

<sup>1</sup> Title used in meeting agendas and file archives

<sup>2</sup> One or more from the following list: W = wet systems; D = dry systems; F = particle formation; SR = size reduction; M = modeling; SE = systems engineering

<b>Recommended Contractors (2 or 3)</b>		
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**Tere Carvajal's input:**

Often during manufacturing, the properties of particles are modified bringing some detrimental consequences. A fundamental insight of the consequences of milling to the surface of materials will help the long-term aim which is to control the behavior of particles. Probing materials at the surface (interactions, composition, phase transformation) using surface characterization tools is necessary to understand the energetic distribution produced by the milling process. Milling brings to the creation of defects that leads either to amorphization or dislocations. At the surface, it was observed that the surface energetics is higher for dislocated crystalline material, followed by the crystalline and then by the amorphous material. At first glance, this are counterintuitive results but actually, it is a direct result of the relaxation (annealing) phenomena of that. The milled crystalline particles are more reactive at the surface, whereas at the inner core, amorphous materials are highly energetic. This is important, because at the end, powders interact first at the surface not at the core. The process of milled materials and the characterization thereof for various active pharmaceutical ingredients such as griseofulvin, felodipine, itraconazole are some examples. Probing the surface energy heterogeneity of milled powders is an objective measurement of the ability of powders to interact at the surface.

### Some References:

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Sai P. Chamorthy, Rodolfo Pinal and **M. Teresa Carvajal**. Elucidating Raw Material Variability—Importance of Surface Properties and Functionality in Pharmaceutical Powders. *AAPS PharmSciTech.* 10:780-788 (2009).

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BE. Chávez Montes JM. Martínez-Alejo, H. Lozano-Perez, JC. Gumy, D. Zemlyanov and **MT. Carvajal**. A Surface Characterization Platform Approach to Study Flowability of Food Powders. *Powder Technology* 357: 269-280 (2019).

### Some Researchers of Interest

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