Hydration Layer: A Potential Key to Manage Colloidal Processing of Oxide Nanopowder Suspensions

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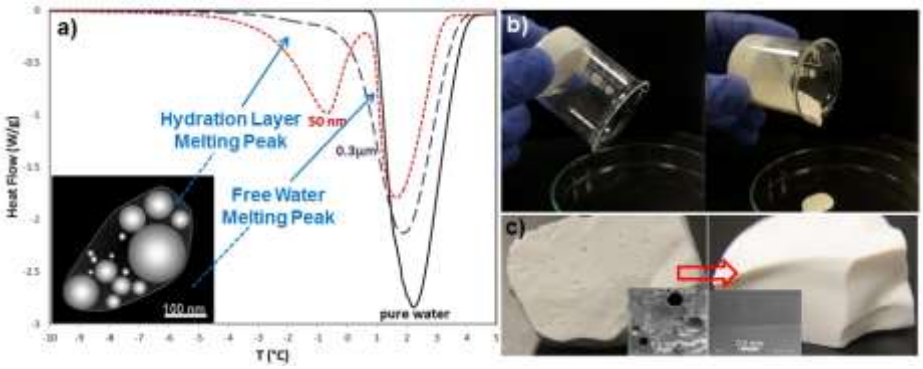
Keywords: hydration of oxides, rheological behavior of nanopowder suspensions

The majority of ceramic processing techniques relies on the successful slurry preparation that ensures homogeneous distribution of powders in a highly loaded slurry with manageable flow characteristics. Only with effective slurry formulation, crack- and pore- free structures can ultimately be manufactured. However, this still remain a challenging issue for advancing technology of additive manufacturing. The available models to predict the colloidal properties of nanopowder slurries therefore require improvements. This presentation will show the presence and importance of hydration layer around oxide nanopowders that has been overlooked till very recently. Then, the influence of the hydration layer on the colloidal properties of oxide nanopowder slurries has been discussed. When the Krieger-Dougherty relation is modified according to the presence of hydration layer, the viscosity of suspensions can be successfully estimated. The resultant improvement in green body quality achieved is also demonstrated.

Figures



DSC thermogram of water exhibits a secondary melting peak in the presence of oxide nanopowders (a).[1,2] Direct imaging of alumina nanopowders in an aqueous environment using fluid cell STEM proved the presence of hydration layer around powders (a-inset).[3] Control over the hydration layer and the electrical double layer of oxide powder enabled to reduce the viscosity of suspension (b), and lead to the pore-free green bodies with finer surface finish (c).[4] Figure a, a-inset and c are adapted from references 1, 3 and 4, respectively.

Acknowledgments
The part of this study was supported by the National Science Foundation (Grant No. CBET 0931038).

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