20d Energy Consumption during Nanoparticle Production: How Economic Is Dry Synthesis?

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The mass production of oxide nanoparticles is increasing rapidly. Newer and faster processes have been developed in the past few years and are already implemented on an industrial level without specifically addressing inherent differences in energy consumption. We have therefore selected a series of wet-chemistry and dry processes and compared them in terms of energy requirements. Clear differences arise for nanoparticle production using electricity-intensive plasma processes, organic- or chloride-derived flame synthesis and liquid based precipitation processes. In spite of short process chains and elegant reactor design, many dry methods inherently require vastly bigger energy consumption than the multi-step wet processes. We have further found that product composition strongly influences the selection of the preferred method of manufacturing in terms of energy requirement: Metal oxide nanoparticles of light elements with high valency, e.g. titania demand high volumes of organic precursors and traditional processes excel in terms of efficiency. Products with heavier elements, more complex composition and preferably lower valency such as doped ceria, zirconia, and most mixed oxide ceramics may be readily manufactured by recently developed dry processes.

Reference: Osterwalder, N. et al., Energy consumption during nanoparticle production: How economic is dry synthesis, *Journal of Nanoparticle Research*, in review (2005)