MICROWAVE TECHNOLOGY FOR NANOPOWDER PRODUCTION

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In the late ‘90s several publications appeared with the synthesis of ceramic nanoparticles in a microwave plasma [1], in the same period several researchers experimented microwave assisted hydrolysis of oxides from salts solution [2]. Soon after metallic and sulphides nanoparticles were prepared [3,4] together with complex structures, perovskite and ferrite type, as well as metal/ceramic composite nanoparticles [5]. From the beginning of the year 2000 up to now more than 100 papers on the different preparation of nanoparticles with microwave assisted method, a short list can be the following: Plasma torch, hydrothermal, solution chemistry (citrate, polyols, acetate, alkylamine, oxalates routes), combustion, deposition (film, nanopowders, nanocomposites, hot-filament), microemulsions are some of the technologies developed which several time have been proposed for continuous and mass production. Carbon nanotubes and their purification by microwave assisted heating methods can be counted as the new frontiers of the microwave assisted methods of nanostructured particles.

Tentative precipitation with metal hydroxides addition to avoid contamination from alkali has been tested for oxide and mix oxide nanoparticles preparation, nevertheless contamination from aqueous species is still an issue for solution based synthetic routes.

Plasma MW-torch preparation accomplish smaller nanoparticles (below 10 nm) than solution routes (20-200 nm) but with higher tendency to agglomeration. Moreover in gas phase synthetic routes proper addition of dispersant agent is more difficult to achieve and powder manipulation is still a problem. Nanoparticles aggregation in solution routes might help in powders separation since filtering and centrifuging operations are facilitated moreover transportation problems are avoided if stable suspension is prepared.

References

[1] D. Vollath, D. V. Sbazò and J. Hausselt, Synthesis and properties of ceramic nanoparticles and nanocomposites, J. Europ. Ceram. Soc. 1997, 17 [11], 1317.
[2] Q. Li, Y. Wei, Study on Preparing Monodispersed Hematite Nanoparticles by Microwave-induced Hydrolysis of Ferric Salts Solution, Materials Research Bulletin, 1998, 33 [5], 779.
[3] J. R. Brenner, J. B. L. Harkness, M. B. Knickelbein, G. K. Krumdick, C. L. Marshall, Microwave plasma synthesis of carbon-supported ultrafine metal particles, Nanostructured Materials, 1997, 8 [1], 1.
[4] D. Vollath, D. V. Szabó, Synthesis of nanocrystalline MoS2 and WS2 in a microwave plasma, Materials Letters, 1998, 35 [3-4], 236.
[5] V. K. Sankaranarayanan, C. Sreekumar, Precursor synthesis and microwave processing of nickel ferrite nanoparticles, Current Applied Physics, 2003, 3 [2-3], 205.