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Mechanochemical Processing - Past, Present, and Future

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Abstract

It has been demonstrated that novel materials (nanocrystalline, amorphous, and composite) with special properties and enhanced performance can be produced using the mechanical alloying (MA) technique. Mechanochemistry can be employed in a number of solid-state chemical reactions (both organic and inorganic) for synthesis, reduction, exchange, decomposition, etc. Despite its attractiveness, and progress in understanding of the fundamental nature of the processes, the limited use of mechanochemical technologies is due to the state-of-the-art of milling technology. Economically viable processes require more effective equipment designed for specific productivity of a process and the possibility of producing materials with high purity. Successful application of a mechanochemical process can be based on several approaches:
- mechanical activation targeted to change specific defect concentration responsible for the change of reactivity of the solid,
-combination of the mechanochemical process with chemical or thermal treatment,
-use of the mechanochemical product in a powder form rather than in a consolidated form.
Examples of existing commercial applications of mechanochemical and mechanical alloying processes based on material cost/availability approach are presented.

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High Energy Ball Milling of Catalytically Synthesized Carbon Nanotubes

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Abstract

The catalytic chemical vapour deposition (CCVD) process is a simple and practical method for synthesizing carbon nanotubes (CNTs). The CCVD-processed CNTs have usually tangled agglomerates consisting of long nanotubes with lengths ranging from several tens microns to several millimeters. However, for many other applications such as chemical or energy-storage use, it is desirable to have short nanotubes with open tips to facilitate diffusion and chemical reactions.
In the presnt work, we have thoroughly examined ball-milling process to shorten and open CCVD-processed multi-wall carnon nanotubes (MWCNTs). Various ball-milling methods were employed such as dry milling and wet milling varing milling atmospheres and milling agents. Dry milling resulted in rapid collapse of tube structures, while wet milling using organic agents was effective for shortening and opening of nanotubes.