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A Comparative Study Mechanical Properties of Polytetrafluoroethylene Materials Synthesized by Non-Conventional and Conventional Techniques

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Abstract : Polytetrafluoroethylene (PTFE) is a high performance thermoplastic polymer with exceptional physical and chemical properties, such as a high melting temperature, high thermal stability, and very good chemical resistance. Nevertheless, manufacturing PTFE is problematic due to its high melt viscosity (10 12 Pa.s). In practice, it is by now well established that this property presents a serious problem when the classical methods are used to synthesized the dense PTFE materials in particularly hot pressing, high temperature extrusion. In this framework, we use here a new process namely spark plasma sintering (SPS) to elaborate PTFE samples from the micro metric particles powder. It consists in applying simultaneous electric current and pressure directly on the sample powder. By controlling the processing parameters of this technique, a series of PTFE samples are easy obtained and associated to remarkably short time as is reported in an early work. Our central goal in the present study is to understand how the non conventional SPS affects the mechanical properties at room temperature. For this end, a second commercially series of PTFE synthesized by using the extrusion method is investigated. The first data according to the tensile mechanical properties are found to be superior for the first set samples (SPS). However, this trend is not observed for the results obtained from the compression testing. The observed macro-behaviors are correlated to some physical properties of the two series of samples such as their crystallinity or density. Upon a close examination of these properties, we believe the SPS technique can be seen as a promising way to elaborate the polymer having high molecular mass without compromising their mechanical properties.

Keywords : PTFE, extrusion, Spark Plasma Sintering, physical properties, mechanical behavior
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