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ABSTRACT

Viscosity Evolution Along First Melting of Nascent UHMWPE and Attempt of Coarse Grained MD Simulations

M. Salse[1], G.P. Baeza[1], J. Morthomas[1], A. Pommella[1], W. Chevremont[2], O. Lame[1]

[1] Univ Lyon, INSA Lyon, Université Claude Bernard Lyon 1, CNRS, MATEIS, UMR 5510, Villeurbanne 69621, France.
[2] ESRF, The European Synchrotron, 71 avenur des Martyrs, CS40220,38043 Grenoble Cedex 9, France.

A new approach using low amount of Fe nanoparticles fillers in ultra-high molecular weight polyethylene (UHMWPE) nascent powder has been shown to be very efficient for the sintering. The Fe nanoparticles act as local heater by applying an intense magnetic field. Using X-ray photon correlation spectroscopy (XPCS), complemented by in-situ SEM observations and thermal analysis [1], it has clearly been shown that there is a time-decorrelation between the fast recovery of a significant part of the viscoelastic properties and the much slower full re-entanglement process. A rapid re-entanglement was first envisioned by De Gennes, who proposed a very high kinetic process occurring just after the melting point as an “explosion upon melting” [2]. For the latter, the duration of re-entanglement is supposed to be of the order of magnitude of a Rouse time. Our results, conversely, show that the mobility still remain significantly high after around 1 minute at 200°C. To better understand the complex phenomena occurring during the first melting and re-entanglement of UHMWPE, an attempt at modeling by coarse-grained molecular dynamic simulations has been performed to evaluate the mechanisms of the melting explosion of very long chains.

[1] A. Pommela et al. Fate of magnetic nanoparticles during stimu-lated healing of thermoplastic elastomers, ACS Nano (2023).
[2] P.G.De Gennes, Compte Rendu de l’Académie des Sciences 321,363 (1995).