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Facelift of PLLA: Effect of orientation on physical ageing in Poly(L-Lactic Acid) films

and

[1]ETH Zurich, Switzerland
[2]Swiss Federal Laboratories for Materials Science and Technology, Switzerland

Poly(L-lactic acid) (PLLA) is a slow-crystallising polyester which exhibits brittle behaviour due to relatively fast physical ageing of the amorphous phase. is embrittlement of PLLA narrows its application window in such elds where exibility of a polymer is required (e.g., packaging). In this study, we investigated the e ects of thermal rejuvenation and molecular orientation of the amorphous phase on physical ageing of oriented PLLA lms with emphasis on mechanical properties. Uniaxial compression testing showed that physical ageing of the amorphous phase increases the yield stress and the associated strain so ening response, both contributing to the observed embrittlement of PLLA in tension. Moreover, the strain-hardening response was found not to be in uenced by physical ageing. Molecular orientation of the amorphous phase at constant crystallinity was applied by uniaxial and biaxial plastic deformation just above the glass-transition temperature (at 70°C) up to modest plastic strains of 200%, to avoid strain-induced crystallisation. Stress-relaxation experiments combined with tensile testing both as a function of ageing time have revealed that both uniaxial and biaxial plastic deformation in excess of 100% plastic strain, decelerates and possibly prohibits the physical ageing process. e oriented mono laments and lms have improved mechanical properties, such as sti ness, strength and strain-to-break. e latter properties were not a ected by physical ageing during a testing period of 40 days. In addition, plastic deformation to higher draw ratios and/or at slightly higher temperatures (90°C), strongly enhanced crystallinity and resulted in PLLA mono laments and lms that also exhibited tough behaviour not a ected by physical ageing.

Biography

Gagik Ghazaryan is a 3rd year PhD student at the Swiss Federal Institute of Technology Zurich (ETH Zurich), working in the group of Soft Materials. He is also affiliated to the Swiss Federal Laboratories for Materials Science and Technology (Empa) in St. Gallen, Switzerland. He completed his MSc degree in Desalination and Water Treatment at the Ben-Gurion University of the Negev, Israel.

gagik.ghazaryan@mat.ethz.ch

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