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Correlation between state of water and reinforcement mechanism in Poly(lactic acid) OMKAR VYAVAHARE, DAVID NG, HENRY DUNN, SHAW LING HSU, University of Massachusetts Amherst — In this study, interaction between water and Poly(lactic acid)(PLA) and its effect on mechanical properties have been elucidated. Although water absorption in PLA is low (less than 1% by weight or one water molecule per $\sim$ 30 PLA monomeric units) changes in the mechanical properties were observed depending on the sample morphology. It has been established that amorphous PLA can undergo significant structural transformations when exposed to water during physical aging and crystallization. In addition, melt quenched amorphous PLA showed increase in the elastic modulus by 10% upon hydration. The phenomenon was attributed to the presence of bound water having specific interaction with PLA and acting as "crosslinks" between the chains. The hypothesis was supported by spectroscopic evidence showing different states of water in PLA based on degree of crystallinity. OH stretching and bending bands of water absorbed in the amorphous PLA are characteristic of bound water. In contrast, for semicrystalline PLA with 50% degree of crystallinity, hydration led to decreased modulus and absorbed water exhibited bulk water like features. In this case, water would have access to amorphous region but the perturbing effects are limited by the constraints introduced by the crystalline domains.

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