工学系WINGS産学協創教育推進基金

第422回GMSI公開セミナー／第167回WINGSセミナー

Investigating the potential of hydrogel for creative noise management

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Date: Tuesday, April 9, 2024 15:00-16:00

Venue: Faculty of Engineering Bldg. 2, Room 31A

Abstract:

A constitutive fractional derivate based model for tough, doubly crosslinked, single network hydrogels in a wide frequency range is presented. The hydrogel contains both chemical and physical cross-links, the former being covalent bonds while the latter includes such as hydrogen bonds, hydrophobic interactions, π–π interactions, van der Waals interactions and ionic interactions; that is, ion–ion, ion–dipole and dipole–dipole interactions. The model additively separates the contributions from the chemical and physical cross-links to the shear modulus; displaying a frequency independent, almost pure elastic contribution from the chemical cross-links with an additional small superimposed Rouse type, half fractional-order frequency contribution to the chemical storage and to the chemical loss modulus. The constitutive model contains only four material parameters and is useful while mechanically modelling various applications of tough, doubly crosslinked, single network hydrogels in a wide frequency range. One such application is vibration isolation. Traditional vibration isolation systems, using natural rubber vibration isolators, display large peaks for the energy flow from the machine source and into the receiving foundation, at the unavoidable rigid body resonance frequencies. However, tough, doubly cross-linked, single polymer network hydrogels, with both chemical and physical cross-links, show a high loss factor over a specific frequency range, due to the intensive adhesion–deadhesion activities of the physical cross-links. In this seminar, vibration isolators, made of this tough hydrogel, are theoretically applied in a realistic vibration isolation system, displaying several rigid body resonances and various energy flow transmission paths. A simulation model is developed, that includes the previous stress–strain model, and shows a significant reduction of the energy flow peaks. In particular, the reduction is more than 30 times, as compared to the corresponding results using the natural rubber.

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主催：
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