

论文

聚2-丙烯酸酰胺-2-甲基丙磺酸水凝胶-玻璃体系中水凝胶压缩模量对摩擦行为的影响

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摘要:

研究了在玻璃基板表面, 滑动速率( $v$ )为 $10^{-6} \sim 10^0$  m/s的具有不同压缩模量( $E$ )的聚2-丙烯酸酰胺-2-甲基丙磺酸(PAMPS)水凝胶的摩擦行为. 结果表明, 在高摩擦速率( $v > 10^{-3}$  m/s)下, 摩擦力 $f \propto v$ , 呈流体动压润滑特征; 而在低摩擦速率( $v < 10^{-4}$  m/s)区域,  $f$ 随 $v$ 增加略有下降, 不符合流体动压润滑机制. 低速区随 $v$ 增加 $f$ 的下降不是缘于测试过程中正压力的松弛, 而是由水凝胶表面缠结网络剪切变稀及混合润滑共同导致的. 低速区 $f$ 对 $v$ 的敏感性受 $E$ 的影响不大. 与模型预测不同,  $E$ 低的PAMPS水凝胶表现出较低的 $f$ 及临界流体动压润滑速率( $v_c$ ), 这与低 $E$ 的PAMPS水凝胶表面较低的电荷密度及较易形变有关.

关键词: PAMPS水凝胶; 摩擦行为; 压缩模量

Frictional Behavior of Poly(2-acrylamido-2-methylpropanesulfonic acid) Hydrogel-gss System Influence of Compressive Modulus

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Abstract:

The frictional behavior of poly(2-acrylamido-2-methylpropanesulfonic acid) (PAMPS) hydrogel sliding against glass plate in water were studied over a wide sliding velocity region. It reveals that the frictional stress( $f$ ) increases with increase sliding velocity( $v$ ) at high velocity region, and  $f \propto v$  prevails, which is considered as the hydrodynamic lubrication. However, at small  $v$  region,  $f \propto v$  failed and  $f$  decreases slightly as  $v$  increase, which does not obey the hydrodynamic lubrication mechanism. The decrease of  $f$  with  $v$  in small  $v$  region does not arise from the stress relaxation of PAMPS hydrogel during the measurement but the shearing thinning of PAMPS hydrogel surface network and the mixed lubrication. PAMPS gel with high compressive modulus( $E$ ) exhibits high  $f$  than that of hydrogel with small  $E$  at slow  $v$  region, which is not coincide with the model's expectation. At the same time, PAMPS hydrogel with small  $E$  is observed to be easy to form hydrodynamic lubrication than that with large  $E$ . This is believed to be related to the excellent deforming ability of PAMPS hydrogel with small  $E$ .

Keywords: Poly(2-acrylamido-2-methylpropanesulfonic acid) hydrogel; Frictional behavior; Compressive modulus

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