Synthesis of Layered Octadecyltrimethylammonium-Templated Aluminosilicate and its Use as a Thickening Agent for Lubricating Grease

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Abstract

We describe herein the use of octadecyltrimethylammonium-templated aluminosilicate (designated as LS) as a thickener to induce gelation. LS samples with different aluminum/silicon molar ratios ($\text{Al/Si} = 0, 0.05, 0.10, 0.15, 0.20$) were synthesized hydrothermally and characterized by X-ray diffraction analysis, ^{27}Al MAS NMR spectra, elemental analysis, and scanning electron microscopy. The aluminum/silicon molar ratio was shown to be an important factor affecting the rheological properties of LS gels. With increasing Al/Si molar ratio, the viscoelasticity and structural strength of LS gel were enhanced, the dropping point increased, and the amount of oil separation decreased. LS(0.20) gel exhibited superior relative elastic character. The strength of the LS(0.20) gel was also enhanced with increasing LS(0.20) content. In SRV tests, LS(0.20) gel with different contents showed good performance in terms of load-bearing ability and anti-wear property, indicating that LS was strongly adhered on the friction surface, and thereby promoted lubrication. Owing to simple preparation, the promising rheological and tribological properties, LS gel hold great potential application in lubricating grease.

Full-text

Due to technical limitations, full-text HTML conversion of this manuscript could not be completed. However, the manuscript can be downloaded and accessed as a PDF.

Figures

Figure 1

XRD patterns of LS with different Al/Si molar ratios.

Figure 2

^{27}Al MAS NMR spectra of LS with different Al/Si molar ratios.

Figure 3

Modulus curves of LS(0) gel and LS(0.20) gel.

Figure 4

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Figure 5

Viscosity curves of 20 wt.% LS gels with different Al/Si molar ratios.

Figure 6

Thixotropic properties of 20 wt.% LS gels with different Al/Si molar ratios.

Figure 7

Modulus curves for LS(0.20) gels with different LS(0.20) contents.

Figure 8

Evolution of the storage and loss moduli (a) and $\tan\delta$ (b) with frequency for LS(0.20) gels with different LS(0.20) contents.

Figure 9

Viscosity curves of LS(0.20) gels with different LS(0.20) contents.

Figure 10

Thixotropic properties of LS(0.20) gels with different LS(0.20) contents.

Figure 11

Variation in wear volumes with applied load for each LS gel.

Figure 12

Variation in the mean friction coefficient with applied load (a) and dynamic friction coefficient for each LS gel under 500 N (b).

Figure 13

SEM, 3D images, and EDS analysis of steel disc tracks for each LS gel under its highest applied load.

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