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Polydimethylsiloxane/Glass-Based Composite Elastomer for Thermophysical Applications

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Abstract. The possibility of reducing the thermal conductivity of the composite material based on polydimethylsiloxane by adding hollow glass microspheres as fillers was tested. Based on the data obtained, it can be concluded that a composite material containing microspheres at a concentration of 2.5% has a lower thermal conductivity coefficient by 40%, but also loses adhesion work and transparency in the optical range.

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REFERENCES

[1] J.-Y. Kim, K.-S. Jang, *facile fabrication of stretchable electrodes by sedimentation of ag nanoparticles in PDMS matrix*, Journal of Nanomaterials, 2018, vol. 2018, art. no. 4580921.
[2] L. Chen, C. Ma, L. Li, C. Zhu, J. Gu, H. Gao, Z. Zhu, C. Du, T. Wang, J. Xu, G. Chen, *using PDMS plasma cavity SERS substrate for the detection of aspartame*, Journal of Spectroscopy, 2020, vol. 2020, art. no. 4212787.
[3] M.P. Wolf, G.B. Salieb-Beugelaar, P. Hunziker, *PDMS with designer functionalities—Properties, modifications strategies, and applications* // Progress in Polymer Science, 2018, vol. 83, pp. 97–134.

[4] D. Cambié, C. Bottecchia, N.J.W. Straathof, V. Hessel, T. Noël, *Applications of continuous-flow photochemistry in organic synthesis, material science, and water treatment*, Chemical Reviews, 2016, vol. 116, no. 17, pp. 10276–10341.
[5] S. Chowdhury, M. Olima, Y. Liu, M. Saha, J. Bergman, T. Robison, *Poly dimethylsiloxane/carbon nanofiber nanocomposites: fabrication and characterization of electrical and thermal properties*, International Journal of Smart and Nano Materials, 2016, vol. 7, no. 4, pp. 236–247.
[6] H.M. Kim, Y.J. Noh, J. Yu, S.Y. Kim, J.R. Youn, *Silica aerogel/polyvinyl alcohol (PVA) insulation composites with preserved aerogel pores using interfaces between the superhydrophobic aerogel and hydrophilic PVA solution*, Composites Part A: Applied Science and Manufacturing, 2015, vol. 75, pp. 39–45.
[7] Y. Kim, M. Kim, H.-G. Seong, J.Y. Jung, S.-H. Baeck, S.E. Shim, *Roles of silica-coated layer on graphite for thermal conductivity, heat dissipation, thermal stability, and electrical resistivity of polymer composites*, Polymer, 2018, vol. 148, pp. 295–302.
[8] Y.-F. Zhang, Y.-J. Ren, H.-C. Guo, S. Bai, *Enhanced thermal properties of PDMS composites containing vertically aligned graphene tubes*, Applied Thermal Engineering, 2019, vol. 150, pp. 840–848.
[9] N. Al-Khudary, P.Y. Cresson, Y. Orlic, P. Coquet, P. Pernod, T. Lasri, *Measurement of the thermal conductivity of polydimethylsiloxane polymer using the three omega method*, Key Engineering Materials, 2014, vol. 613, pp. 259–266.
[10] J.-H. Hao, Q. Chen, K. Hu, *Porosity distribution optimization of insulation materials by the variational method*, International Journal of Heat and Mass Transfer, 2016, vol. 92, pp. 1–7.
[11] I.-L. Ngo, S. Jeon, C. Byon, *Thermal conductivity of transparent and flexible polymers containing fillers: A literature review*, International Journal of Heat and Mass Transfer, 2016, vol. 98, pp. 219–226.
[12] S. Vlassov, S. Oras, M. Timusk, V. Zadin, T. Tiirats, I.M. Sosnin, R. Lõhmus, A. Linarts, A. Kyritsakis, L.M. Dorogin, *Thermal, mechanical, and acoustic properties of polydimethylsiloxane filled with hollow glass microspheres*, Materials, 2022, vol. 15, no. 5, art. no. 1652.
[13] H. Lee, D. Lee, J. Cho, Y.-O. Kim, S Lim, S. Youn, Y.C. Jung, S.Y. Kim, D.G. Seong, *Super-insulating, flame-retardant, and flexible poly(dimethylsiloxane) composites based on silica aerogel*, Composites Part A: Applied Science and Manufacturing, 2019, vol. 123, pp. 108–113.
[14] D. Ge, L. Yang, Y. Li, J. Zhao, *Hydrophobic and thermal insulation properties of silica aerogel/epoxy composite*, Journal of Non-Crystalline Solids, 2009, vol. 355, no. 52–54, pp. 2610–2615.
[15] S.Y. Kim, Y.J. Noh, J. Lim, N.-H. You, *Silica aerogel/polyimide composites with preserved aerogel pores using multi-step curing*, Macromolecular Research, 2014, vol. 22, no. 1, pp. 108–111.
[16] H.M. Kim, H.S. Kim, S.Y. Kim, J.R. Youn, *Silica aerogel/epoxy composites with preserved aerogel pores and low thermal conductivity*, e-Polymers, 2015, vol. 15, no. 2, pp. 111–117.
[17] M. Vahtrus, S. Oras, M. Antsov, V. Reedo, U. Mäeorg, A. Lõhmus, K. Saal, R. Lõhmus, *Mechanical and thermal properties of epoxy composite thermal insulators filled with silica aerogel and hollow glass microspheres*, Proceedings of the Estonian Academy of Sciences, 2017, vol. 66, no. 4, pp. 339–346.
[18] C. Zhang, L. Qu, Y. Wang, T. Xu, C. Zhang, *Thermal insulation and stability of polysiloxane foams containing hydroxyl-terminated polydimethylsiloxanes*, RSC Advances, 2018, vol. 8, pp. 9901–9909.
[19] A. Trofimov, L. Pleshkov, H. Back, *Hollow glass microspheres for high strength composite cores*, Reinforced Plastics, 2006, vol. 50, no. 7, pp. 44–46, 48–50.
[20] Y. Hu, R. Mei, Z. An, J. Zhang, *Silicon rubber/hollow glass microsphere composites: Influence of broken hollow glass microsphere on mechanical and thermal insulation property*, Composites Science and Technology, 2013, vol. 79, pp. 64–69.
[21] A. Tiwari, L. Dorogin, A.I. Bennett, K.D. Schulze, W.G. Sawyer, M. Tahir, G. Heinrich, B.N.J. Persson, *The effect of surface roughness and viscoelasticity on rubber adhesion*, Soft Matter, 2017, vol. 13, no. 19, pp. 3602–3621.
[22] Q. Yu, *Application of foam glass-ceramic composite thermal insulation material in traditional buildings*, Journal of Chemistry, 2022, vol. 2022, art. no. 9662805.
[23] C.-K. Jeon, J.-S. Lee, H. Chung, J.-H. Kim, J.-P. Park, *A study on insulation characteristics of glass wool and mineral wool coated with a polysiloxane agent*, Advances in Materials Science and Engineering, 2017, vol. 2017, art. no. 3938965.