Robust self-lubricating poly(urea-formaldehyde) microcapsules designed/designated for thermal spaying coating applications

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Traditional lubricating methods are limited by working conditions, physical and chemical characteristics and durability over extended periods of usage in severe environments. New smart materials need to be developed in order to increase effectiveness and stability of lubrication, improving reliability and lifetime of manufactured products, also reducing wastes of natural resources and energy. Introducing microcapsules (MCs) containing lubricant into the surface of moving parts, significantly improves anti-friction properties and wear resistance. When the surface is subjected to friction, MCs are ruptured and the encapsulated lubricants are released, forming a boundary lubrication film that significantly reduces the friction coefficient and wear rate[1]. The aim of the current work is to produce poly(urea-formaldehyde) microcapsules (PUF MCs) with an encapsulated lubricating oil to be used in metal coating produced *via* thermal spraying. PUF MCs preparation was carried out by one stage *in situ* polymerization in an oil-water emulsion[2,3]. Key process parameters i.e. core to wall mass ratio and agitation rate were studied in respect to microcapsule characteristics. Spherical microcapsules were obtained as free-flowing white powder with a mean diameter from 57 to 88 μm, high encapsulation efficiency (up to 79 %) and increased thermal stability (onset of degradation $T_{d5\%}$ > 210 °C, maximum of thermal degradation Td >340°C).

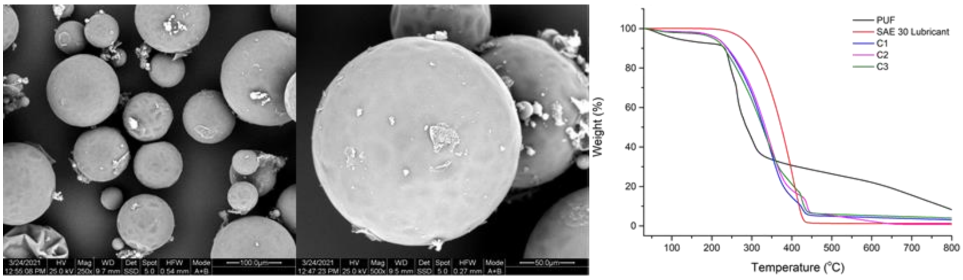

Figure 1: SEM images and TGA graph of microcapsule samples

Keywords: poly(urea-formaldehyde), microcapsules, *in situ* polymerization, self-lubrication

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References

[1] Gong, H.; Yu, C.; Zhang, L.; Xie, G.; Guo, D.; Luo, J. Intelligent lubricating materials: A review Compos. Part B Eng. 202 (2020) 108450

[2] Zotiadis, C.; Patrikalos, I.; Loukaidou, V.; Korres, D.M.; Karantonis, A.; Vouyiouka, S. Self-healing coatings based on poly(urea-formaldehyde) microcapsules: In situ polymerization, capsule properties and application Prog. Org. Coatings. 161 (2021) 106475.

[3] Tzavidi, S.; Zotiadis, C.; Porfyris, A.; Korres, D.M.; Vouyiouka, S. Epoxy loaded poly(urea-formaldehyde) microcapsules via in situ polymerization designated for self-healing coatings, J. Appl. Polym. Sci. 137 (2020) 1–11.