Accepted Manuscript

Friction-induced transfer of carbon quantum dots on the interface: Microscopic and spectroscopic studies on the role of inorganic–organic hybrid nanoparticles as multifunctional additive for enhanced lubrication

Mengting Ye, Tao Cai, Wangji Shang, Lina Zhao, Yunxiao Zhang, Dan Liu, Shenggao Liu

PII: S0301-679X(18)30325-6

DOI: 10.1016/j.triboint.2018.06.033

Reference: JTRI 5291

To appear in: *Tribology International*

Received Date: 27 February 2018

Revised Date: 8 June 2018

Accepted Date: 25 June 2018

Please cite this article as: Ye M, Cai T, Shang W, Zhao L, Zhang Y, Liu D, Liu S, Friction-induced transfer of carbon quantum dots on the interface: Microscopic and spectroscopic studies on the role of inorganic–organic hybrid nanoparticles as multifunctional additive for enhanced lubrication, *Tribology International* (2018), doi: 10.1016/j.triboint.2018.06.033.

Friction-induced transfer of carbon quantum dots on the interface: Microscopic and spectroscopic studies on the role of inorganic–organic hybrid nanoparticles as multifunctional additive for enhanced lubrication

Mengting Ye,[a, b] Tao Cai,*[, a] Wangji Shang,[a, c] Lina Zhao,[a, b] Yunxiao Zhang,[a, c] Dan Liu,[a] and Shenggao Liu**[, a]

[a] Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences. No. 1219, Zhongguan West Road, Ningbo City, Zhejiang Province 315201 PR China

[b] University of Chinese Academy of Sciences, Beijing 100049, PR China

[c] School of Materials Science and Engineering, Shanghai University, NO.99, Shangda Road, Shanghai, 200444, P.R. China

**Corresponding Author: ***Tao Cai, e-mail, caitao@nimte.ac.cn

**Shenggao Liu, e-mail, sliu@nimte.ac.cn

Abstract

Inorganic–organic hybrid carbon quantum dots (CQDs) attached the structure of diphenylamine (DPA) on the surfaces ($CQDs_{-N}$) have been successfully prepared by one-step pyrolysis method at lower temperature. The obtained N-doped carbon dots ($CQDs_{-N}$) were spherical particles with a narrow size distribution exhibiting excitation-dependent nature, which are also proved to be an multifunctional additive exhibiting not only antioxidant but also antiwear and friction-reducing performances. Even tested under higher load, $CQDs_{-N}$ still exhibited superior friction-reducing performance till now in polyethylene glycol (PEG) for steel/steel pairs. The function of $CQDs_{-N}$ with polar nature, acting as bearing balls and depositing on the interface to form non-uniform protective film, might account for the excellent antiwear and friction-reducing performances under boundary lubrication.

Keywords: Inorganic–organic hybrid carbon quantum dots; contact interfaces; antioxidant; lubrication mechanism.

1. Introduction