Tribocorrosion behavior of martensitic stainless cutlery steel in fruit and vegetable juices

Liya Guo[1,2], Jiahao Xie[1], Huan Teng[1], Hongshan Zhao[1,2], Xicheng Wei[1,2], Han Dong[1,2]

[1]*School of Materials Science and Engineering, Shanghai University, Shanghai 200444, China*

[2]*Zhejiang Institute of Advanced Materials, Shanghai University, Jiaxing 314100, China*

liya_guo@shu.edu.cn

Abstract The martensitic stainless cutlery steel is frequently exposed to conditions where there were both wear and corrosion in the daily usage of kitchen cutlery. To understand the degradation mechanism of the cutlery steel under practical application environments, tribocorrosion tests were performed on 60Cr16MoMA martensitic stainless steel (MSS) in 3.5 wt% NaCl solution, pressed Shanghai Bok Choy (pSBC) and lemon juice. The results revealed that compared with 3.5 wt% NaCl solution, the 60Cr16MoMA steel exhibited better tribocorrosion resistance in pSBC during sliding. Through analysis of cross-sectional wear track proffles, it was found that the 60Cr16MoMA steel had the least volume loss when tested in pSBC. High performance liquid chromatography-mass spectrometry results showed that ffavonoids and ascorbic acid were present in pSBC, which may act as corrosion inhibitors and stabilize the passive fflm through physisorption or chemisorption. X-ray photoelectron spectrometer results further conffrmed that the passive fflm formed in pSBC was more stable due to higher Fe^{2+}/Fe^{3+} and $Cr_2O_3/Cr(OH)_3$ ratios. Apart from the types of solutions, the tribocorrosion behavior of cutlery MSS was also closey related to the carbides and passive film formed. These findings further confirm the MSS are subjected to the hazards of wear, corrosion and tribocorrosion, and provide important empirical and theoretical support for evaluating cutlery steel volume loss in practical application environments in the future.

Keywords Tribocorrosion, Sliding, Martensitic stainless steel