致谢:感谢长江学者创新团队的支持。

参考文献:

[1] Shuster M, Seasons R, Burke D. Laboratory Simulation to Select Seal and Surface Treat[J]. Wear, 1999(225-229): 958-961.

[2] Martínez L, Álvarez L, Huttel Y, et al. Surface Analysis of NBR and HNBR Elastomers Modified with Different Plasma Treatments[J]. Vacuum, 2007, 81(11-12): 1489-1492.

[3] Bui X L, Pei Y T, Mulder E D G, et al. Adhesion Improvement of Hydrogenated Diamond-like Carbon Thin Films by Pre-deposition Plasma Treatment of Rubber Substrate[J]. Surface & Coatings Technology, 2009, 203(14-15): 1964-1970.

[4] 彭兵,林生义,向宇,等. 丁腈橡胶动密封件工作面润滑层材料研制[J]. 世界橡胶工业,2010,37(1):19-24.

[5] 金山,冯永海,鲁选才,等. 表面化学处理在丁腈橡胶硫化胶中的应用研究[J]. 特种橡胶制品,2000,21(6):43-46.

[6] 张铃欣,关跃,张立群,等. 含氟涂料表面喷涂改性 HNBR 的摩擦性能[J]. 橡胶工业,2011,58(5):261-268.

[7] Fukahori Yoshihide, Yamazaki Hirotaka. Mechanism of Rubber Abrasion. Part Ⅰ. Abrasion Pattern Formation in Natural Rubber Vulcanizate[J]. Wear, 1994, 171(1-2): 195-202.

[8] 沈德言. 红外光谱法在高分子研究中的应用[M]. 北京:科学出版社,1983:61-75.

[9] Yang E, Hirvonen J P, Räsänen M, et al. Adhesion, Friction and Wear between Polytetrafluoroethylene and Nitrogen-implanted Stainless Steel[J]. Surface and Coatings Technology, 1992, 51(1-3): 146-151.

收稿日期:2013-03-29

Study on Anti-friction Mechanism of NBR Modified by Plasma Surface Fluorination

MI Tong, LU Yong-lai, WANG Zhen-hua, GUAN Yue, ZHANG Li-qun

(Beijing University of Chemical Technology, Beijing 100029, China)

Abstract: The surface of NBR was fluorinated by plasma technology and using carbon tetrafluoride as the reaction gas to improve the anti-friction performance of rubber surface, and the anti-friction mechanism of the modified surface containing fluoride was discussed. The results showed that the surface of rubber was successfully fluorinated after plasma treatment, and the friction coefficient was reduced significantly compared with that of the unmodified sample. The plasma power was the key processing parameter influencing the anti-friction performance of modified sample. Improper modification power(either higher or lower) would result in low fluorine content on the surface of the sample. When the processing power was 140 W, the modified sample surface was smooth after friction test, the adhesion between the fluorinated layer and the NBR substrate was good, the fluoride was distributed uniformly, and the anti-friction effect was the best.

Key words: plasma modification; surface fluorination; NBR; anti-friction

一种提高天然橡胶粘结性能的表面处理方法

中图分类号:TQ332.5 **文献标志码**:D

由中北大学申请的专利(公开号 CN 102140180A,公开日期 2011-08-03)"一种提高天然橡胶粘结性能的表面处理方法",提供了一种提高天然橡胶(NR)粘合性能的表面处理方法,包括以下步骤:(1)配制质量分数为 0.5~0.95 的硫酸水溶液。(2)制备 NR 硫化胶。先在开炼机上对 NR 进行塑炼,包辊后依次加入硬脂酸、氧化锌、防老剂、炭黑、促进剂和硫化剂进行混炼,混炼均匀后下片,得到 NR 混炼胶,将 NR 混炼胶在室温下放置 24 h 后进行硫化,制得 NR 硫化胶。(3)使用硫酸水溶液对 NR 硫化胶进行表面处理。(4)粘接。将经过表面处理的 NR 硫化胶片表面涂覆 Chemlok 250,经处理后获得 NR/NR 片材或者 NR/聚氨酯(PU)片材。该橡胶表面处理方法可以在轮胎、减震器以及制鞋等工业中广泛应用。

(本刊编辑部 赵 敏)