Academic Journal of Polymer Science
ISSN: 2641-8282

Juniper Publishers
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Mini Review
Volume 1 Issue 4 - August 2018
DOI: 10.19080/AJOP.2018.01.555566

Academ J Polym Sci

The Making Process of Go/CT/PTFE Flat Sliding Plate of High-Speed Railway Bridge Spherical Bearings

Li-hu Wang, Shou-ren Wang*, Dao-sheng Wen, Gao-qi Wang and Pei-wen Wang

School of Mechanical Engineering, Jinan University, China

Submission: July 02, 2018**; Published:** August 02, 2018

***Corresponding author:** Shou-ren Wang, School of Mechanical Engineering, Jinan University, China, Email: sherman0158@tom.com

Abstract

According to the rapid development of high-speed railway, the importance of spherical bridge bearings has attracted lots of attention as an essential connected part between bridge and pillar [1,2]. As you know, high-speed railway spherical bearings consist of upper bearings plate, spherical plate, under plate, flat stainless-steel plate, flat sliding plate, spherical stainless steel plate, spherical sliding plate, sealing ring, anchor bolt, dustproof shield [3,4]. Flat sliding plate is an indispensable part of spherical bearings since the displacement ability of bearings is determined by the sliding behavior between flat stainless-steel plate and flat sliding plate.

Keywords: Spherical bridge; Steel plate; Sealing ring; Cold pressing

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Now the flat plate is made of PTFE, which is categorized as a chemical polymer and usually called "the king of plastic". As PTFE has a great ability of friction and wear, it has been used widely. However, PTFE behave badly in creep deformation resistance unless adding to original PTFE extra material which could improve the performance to against creep deformation. One of the well-known extra adding materials is GO [5,6]. GO is a kind of two-dimension nanometer material with hive-like flat thin film, which is made of sp2 and found in 2004. Although GO is as thick as one carbon atom, it has high level yield strength and stiffness, great lubricant performance and excellent wear-resistance attribute, and it means that GO could reduce friction coefficient if it mixes with PTFE [7,8]. Another adding material called CF which also has high level yield strength and elasticity and could be added to PTFE to improve the wear resistance of material. But, both GO and CF show low compatibility with PTFE as adding material and many scholars and experts have focused on this phenomenon. In this paper, it shows a new kind of making process of Go/CF/PTFE flat sliding plate of high-speed railway bridge spherical bearings by KH-550

Weighing Material and Mixing Material

The experimental material is weighed by electronic universal analytical balance and then placed in grinding room of planetary ball mill. The parameters are showed below.

Grinding time: 240 minutes, rotate rate: 180r/min, the ratio of ball to sample: 7:1

Cold Pressing

Put the sample into mold (Figure 1), and then Universal hydraulic forming machine could press the sample. With 10MPa/min press velocity, the load pressure should increase gradually to 130MPa and stay for 10 minutes, to make sure the air among the sample could be expelled entirely.

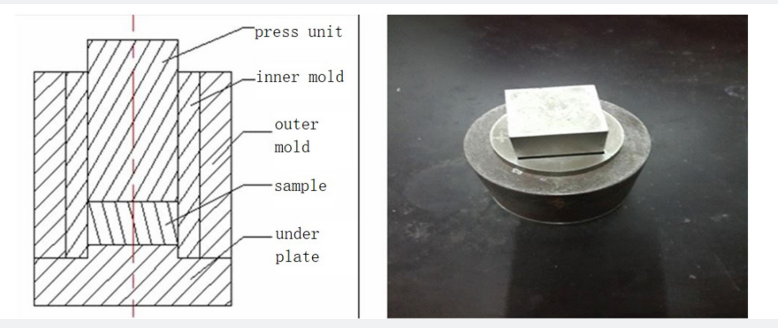

Figure 1: Cold pressing mold.

Sintering Solidification

After cold pressing process, the sample should be placed into electric furnace for sintering. Figure 2 shows process flow diagram. With 60 °C/h heating velocity, the sample should be heated up to 327 °C, which is the melting point of the sample, and then keep the temperature for 30 minutes. And then the sample should be heated up to 375 °C and keep the temperature for 2 hours. After furnace cooling process, the sample could be considered well-prepared [9].

Microstructure Analysis

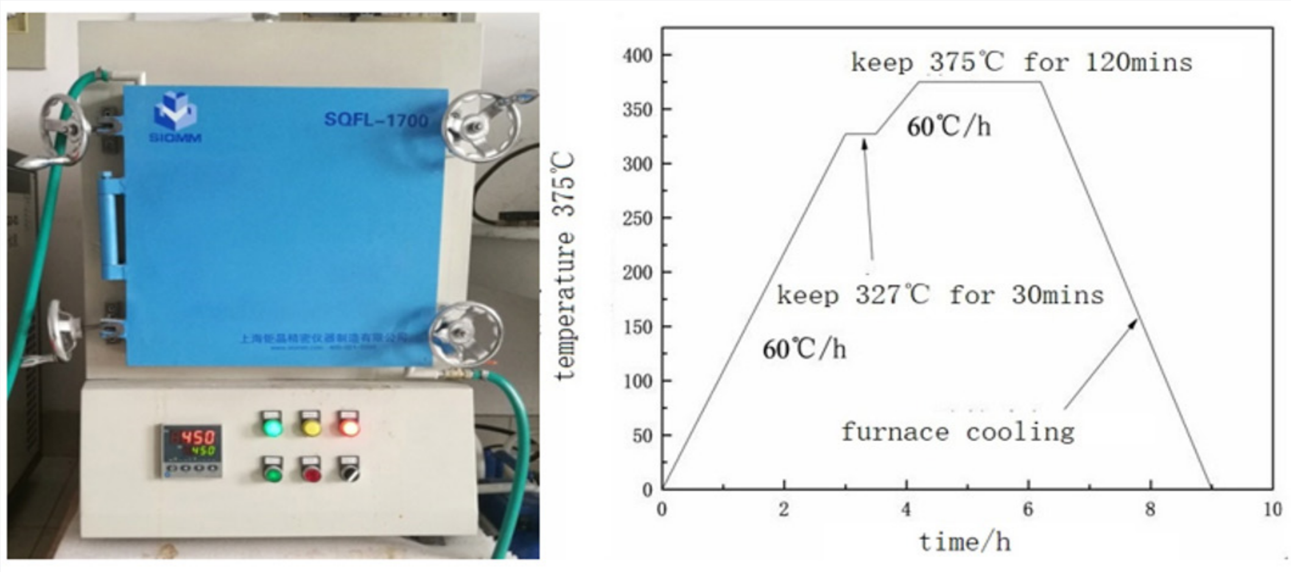

Figure 2: (a) Sintering furnace and (b) sintering process flow diagram.

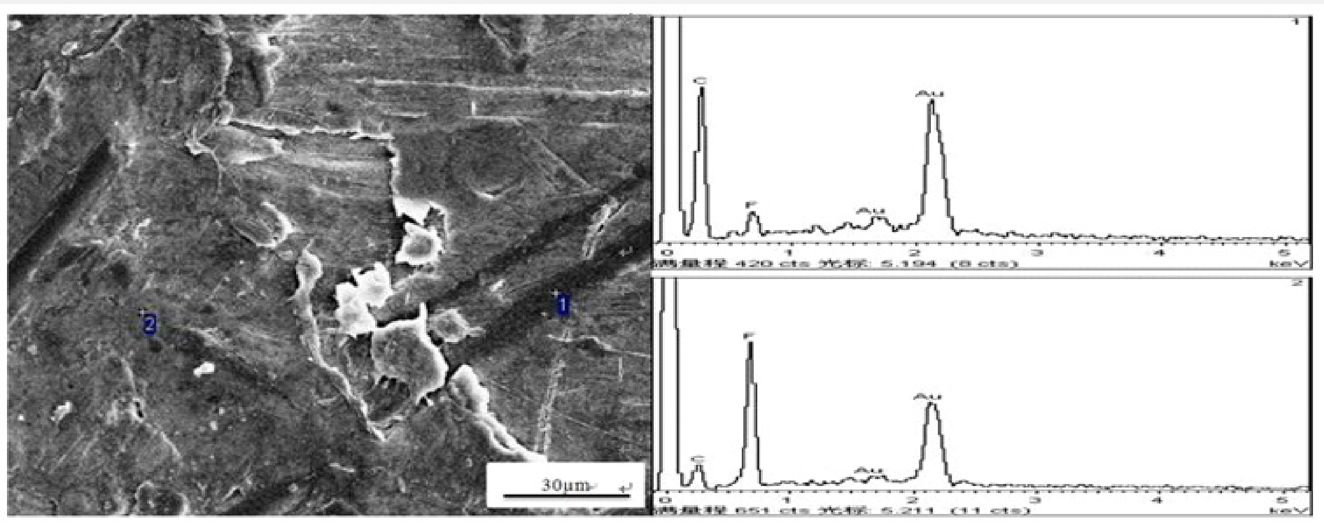

Figure 3: Sample S's spot scanning of energy spectrum.

After making process of flat sliding plate, microstructure analysis could be completed. Figure 3 shows sample S's spot scanning of energy spectrum and Figure 4 shows sample S's map scanning of energy spectrum. In Figure 3, area 1 shows trace of black strip, which is CF, and area 2 shows matrix material. Figure 4 also shows that CF has been distributed evenly in the matrix material, and it means than CF has relatively good compatibility and it could improve some kinds of strength property of sliding plate sample [10]. Figure 5 shows the impact section micro-structure of composite sample. We can conclude that the interface issue was not good from area 1 in Figure 5.

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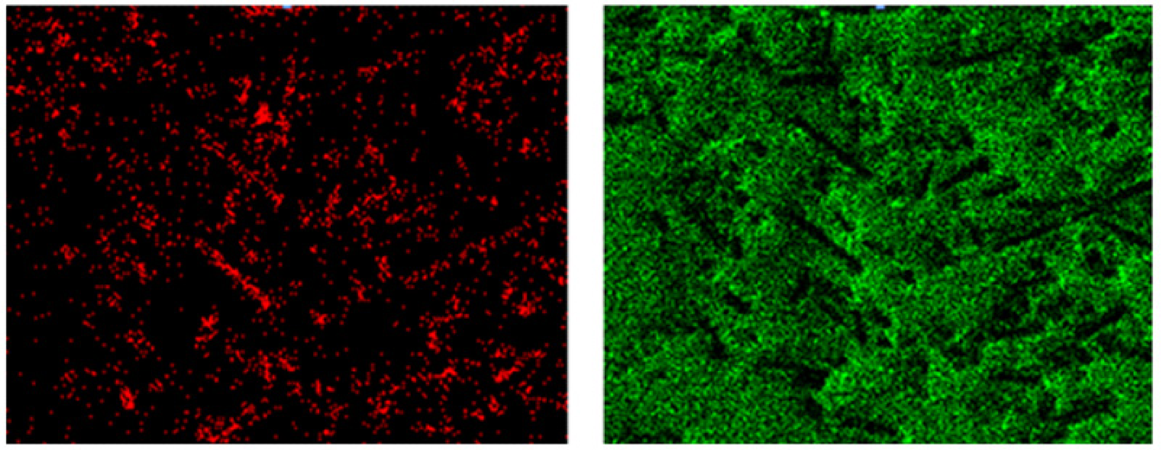

Figure 4: Sample S's map scanning of energy spectrum (a) CF(red trace); (b)matrix (green trace).

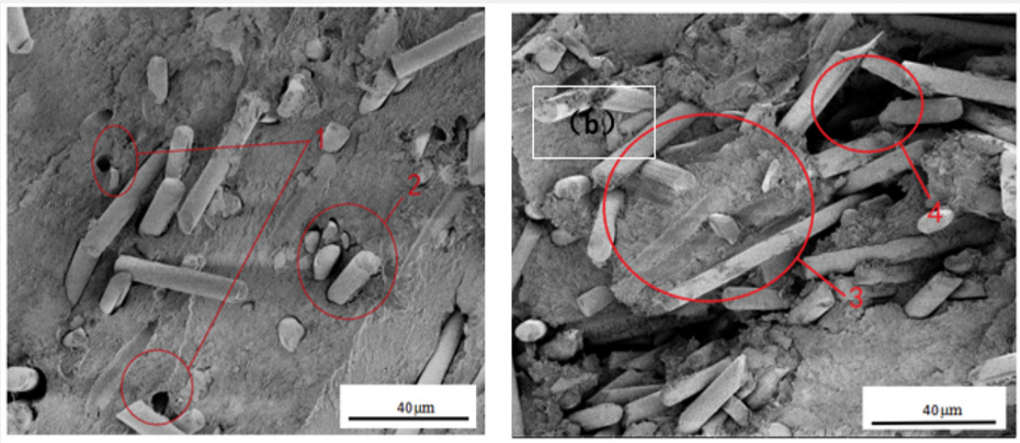

Figure 5: Composites Specimen Impact Section(a) CF losening; (b) CF aggregat.

CF was extracted out from the material when it was impacted. The combination between CF and matrix would turn to be loose. Maybe it was caused by the incomplete disposition by silane coupling agent, or the silane coupling agent disposition couldn't improve the interface issue between CF and PTFE. The tight combination between CF and matrix which is shown on area 3 in Figure 5, which proved that the interface issue was solved seemingly. What is shown on area 2 in Figure 5 is that the mid area of CF has been broken, which proved that CF could strengthen the matrix. Area 4 in Figure 5 has shown the gaps in composite material sample. Maybe it was caused by the fast compressing rate of cold-press molding, or the liquid evaporation during sintering process which was attributed to the halfway drying of sample.

Conclusion

Bearings' sliding plate sample could be made by cooling press process and sintering solidification successfully, and since CF could be distributed evenly among matrix, it illustrates that CF could reduce wear and friction for material.

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