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Fast carbon/carbon composite densification with vegetable oils.

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Abstract – Carbon-carbon materials are very interesting material to space applications, but the usual methods to fabricate this material are time consuming and use special reagents, so their are expensive. This work shows the result of a fast densification process using a vegetable oil as a carbon precursor.

Carbon-carbon pieces are expensive due to the fabrication process used. Now a day there are 2 ways to produce carbon-carbon composites, one by impregnation and pyrolysis of carbon precursor resins that uses many cycles, on by gas-solid reactions in CVI (chemical vapor infiltration) expensive reactor. Both processes are laborious, use expensive equipment, are time consuming and waste a lot of energy and reagents [1]. But a process called CLVI (chemical liquid-vaporized infiltration) that presents very high deposition rate, achieving 16g/min, has been study for years [2,3]. This new process has more options of carbon precursors enabling to use not refined or nature ones. In this work a vegetable oil, soy bean oil, was used to densified a carbon felt by the CLVI process showing the possibilities to this new technique.

The experimental procedure uses a small reactor showed in figure 1. A graphite electrode of 0,35 mm in diameter was passed through a 5 mm thick and 20 mm long carbon felt. The reactor was supplied with soy oil and an N_2 inert atmosphere was used to avoid any possible combustion. The reactor was mounted with gas condensers and an electric power supply (not shown). The densification begun supplying 100 W and finished 5 minutes later using 750 W.

Figure 2 shows the result of this densification, the round central body in the MEV is the graphite electrode; the left border of the figure shows the undensified felt. The densified region has a diameter of 3,55 mm, but it is porous. The porosity can be seen in higher magnifications. The final body mass gain was 0,73 g and the process took about 1 minute. This densification rate is much larger than any CVI process. The main problem with oils is their high viscosity and high boiling point that difficult the supply of new reagents in the vapor form to deposit carbon in the densification front. Experiments made with hexane, and other mineral hydrocarbons, show no porous region, but the densification rate is slightly smaller.

CLVI is a simple, fast and cheap densification process to carbon-carbon materials. Vegetable oils are promising candidates to porous parts such as filters.

Figure 1: Photo of the CLVI reactor.

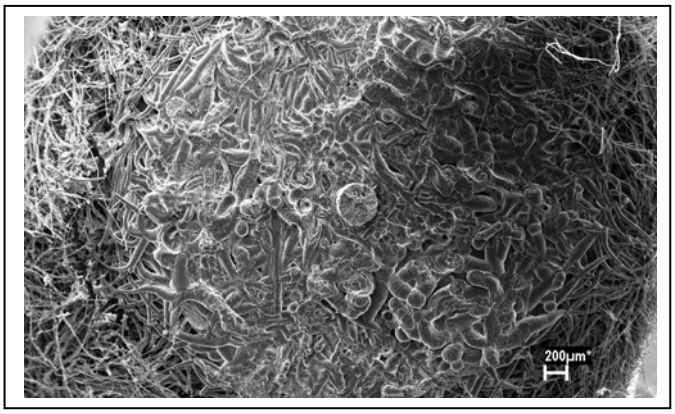

Figure 2: Densified region with soy bean oil.

References

[1] I. GOLECKI. Materials Science and Engineering, R20 (1997) p.37-124.
[2] D. ROVILLAIN, M. TRINQUECOSTE, E. BRUNETON, A. DERRÉ, P. DAVID, P. DELHAÈS. Carbon 39 (2000) 1355-1365.
[3] XIAOWEN WU, RUIYING LUO, JINCAO ZHANG, QIAO XIANG, YONGFENG NI. Carbon, v.47 (2009) p.1429-1435.