Southern Illinois University System

Application

- Protective coating of aircraft brakes

Inventor

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Glass Ceramics-Based Antioxidants for the Oxidation Protection of Carbon-Carbon Composites

Carbon-carbon (C/C) composite brakes are one-third the weight of typical steel brakes and attain their strength and frictional properties at temperatures up to 1600° C. C/C brakes can endure high temperatures, but in the presence of oxygen they will begin to oxidize at 400° C such that anti-oxidant systems must be applied to the non-rubbing C/C composite surfaces. Currently, commercial coating materials made of crystalline metal phosphates that are derived from heat treating phosphoric acid-based liquid precursors and are painted on the surface of carbon-carbon composites. The coatings tend to be porous, discontinuous and sensitive to moisture causing decreased surface friction.

Invention

An SIU researcher has developed a series of methodologies to produce glass-ceramic coating materials for the oxidation protection of C-C composite brakes. The glass-ceramic coating systems are derived from uniquely formulated liquid precursors which, after heat treating, produce dense coatings comprising crystalline ceramic particles that are bonded by a continuous matrix phase of glass. Upon heating, the chemicals turn into an oxide mixture and form a glass-ceramic coating material that penetrates into the carbon-carbon composite to be protected. The base oxides of the glass-ceramic coating and their source raw materials covered in this invention are listed in Table 1.

TABLE 1

Base oxides and raw chemicals for the oxides used in the anti-oxidants.

Base Oxides	Source Raw Materials
P_2O_5	85% H_3PO_4, $Al(H_2PO_4)_3$, KH_2PO_4, NaH_2PO_4, . . .
B_2O_3	B_2O_3, $K_2B_4O_7$*10(H_2O), $Na_2B_4O_7$*4(H_2O), . . .
Al_2O_3	$Al(H_2PO_4)_3$, Al_2O_3, . . .
K_2O	K_2CO_3, KNO_3, KCl, KOH, KH_2PO_4, . . .
Na_2O	$NaCO_3$, $NaNO_3$, NaCl, NaOH, NaH_2PO_4,
CaO	$CaCO_3$, $CaCl_2$
MgO	$MgCO_3$, $MgCl_2$

Key Advantages

- Coating bonds well to and protects C-C composite brakes
- Coating can be produced from a variety of raw materials

Status

U.S. patent #9,388,087 was issued on July 12, 2016. The technology is available for license.

Other opportunities related to this technology, included but not limited to sponsored and/or collaborative research, may be available. Please reach out to the designated contact identified at left for more information.

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