CHEMICALLY COMPATIBILISED PAI-PTFE ANTI-FRICTION COATINGS WITH A HIGH WEAR RESISTANCE

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ABSTRACT
Irradiation modified PTFE (polytetrafluoroethylene) micropowder was processed with PAI (polyamideimide) by reactive extrusion to a chemically grafted and compatibilized PAI-PTFE-cg material which was dissolved in NMP to form a lubricant varnish dispersion. After application and curing on a substrate the anti-friction coating was characterized in terms of mechanical and tribological properties. It could be shown that the PAI-PTFE-cg material is an effective substitute for the white alloy used in hydro-dynamically lubricated floating bearings.

Keywords: PTFE, PAI, reactive extrusion, PAI-PTFE-cg, anti-friction coating, tribology.

INTRODUCTION
PTFE could be modified by e-beam or gamma irradiation in presence of oxygen to form micropowder with functional groups like -COF, -COOH and perfluoroalkylene groups and perfluoroalkyl-(peroxy-)radicals. Groups and radicals are mostly sterically hindered after the irradiation modification. Therefore the mixture of molten PAI and PTFE micopowder has to be processed by reactive extrusion under shear conditions to realize the chemical coupling reaction and compatibilization between PAI and PTFE to form PAI-PTFE-cg. The coupling reaction was proofed after separation of the soluble PAI content by IR-spectroscopy. PAI absorption bands were detected beside the PTFE IR-absorptions as indirect evidence. The compatibilized PAI-PTFE-cg was dissolved in NMP to form the lubricant varnish dispersion.

After application of this dispersion on the metallic substrate surface and curing an anti-friction coating was received. The cured films showed excellent bond strength to the substrate. Coated metal plates could be shaped without any problems to produce e.g. table-tracks for conveying systems.

Regarding tribological properties, the PAI-PTFE anti-friction coatings were investigated with the pin/ball-disc wear test under dry conditions and also with the ring-on-disc tribometer (Siebel/Kehl) under oil lubrication.

RESULTS AND CONCLUSIONS
White alloys as tribological anti-abrasion layer have toxic components like Cd and As. The aim of these investigations is the substitution of the white alloy in hydrodynamic lubricated floating bearings. The bond strength of PAI-PTFE-cg films to the substrate surface was investigated by usual methods like Erichsen cupping and impact tests. The mostly tested films
showed excellent properties independent of PTFE content and kind of used irradiation modified PTFE. The tribological investigation regarding the white alloy substitution was carried out with the ring-on-disc tribometer. The results from these tribological tests are shown in Fig. 1.

Column 1 (red) points the tribological properties of the white alloy. The investigated commercial lubricant varnish (column 2, green) shows a good friction coefficient but a bad wear behavior. Columns 3 - 5 show the investigated PAI-PTFE-cg materials with different composition. The films of columns 3 and 4 basing on irradiated PTFE emulsion polymer are applicable as replacement for white alloy in contrast to column 5 in which was used an irradiated PTFE suspension polymer. In all cases, the lubricant varnishes were formulated under the same conditions. Especially the wear behavior of 3 and 4 is excellent under test conditions what can be explained (a) by the chemical coupling and compatibilization between the PAI matrix and the solid lubricant PTFE and (b) by the excellent distribution and fixation of the irradiation modified PTFE emulsion polymer in the PAI matrix. The developed non-optimized PAI-PTFE-cg materials 3 and 4 can be used as equivalent substitutes for the white alloy e.g. in hydro-dynamically lubricated floating bearings.

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REFERENCES