

On the sliding behavior of PEEK composites in vacuum environment

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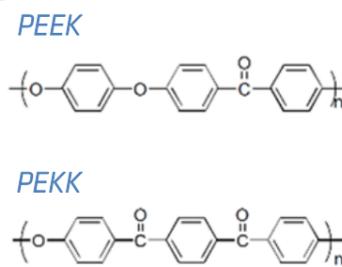
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Abstract

The tribological behavior of PEEK and PEKK composites were investigated in air and vacuum environment. Polymers were filled with either glass (GF) or carbon (CF) fibers and compared with standard materials containing 10% CF, 10% Graphite (Gr) and 10% PTFE. In vacuum, the tribological performance of these compounds depends on material compositions, fiber orientation as well as test conditions. Very low friction and wear coefficient were obtained at low sliding speed while severe wear occurred at high speed. In particular, excessive wear debris of CF filled composites led to ignition after opening the vacuum chamber.

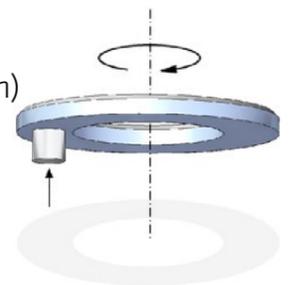
Materials

Name	Fillers
PEEK	-
PEEK30GF	30% GF
PEEK30CF	30% CF
PEEKCFTFGr	10% CF, 10% PTFE, 10% Graphite
PEKK	-
PEKK30CF	30% CF
PEKKCFTFGr	10% CF, 10% PTFE, 10% Graphite

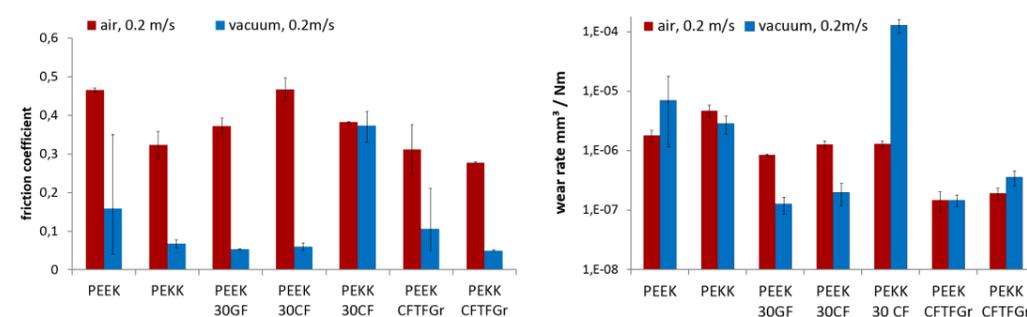


Experiments

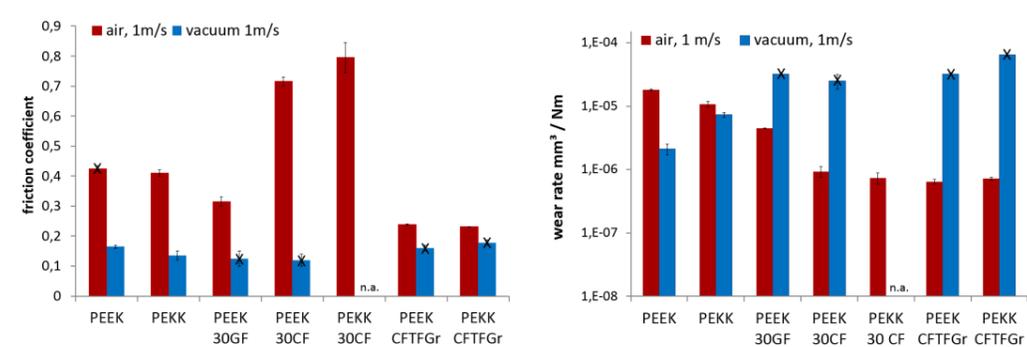
pin-on-disk (52100 steel, $R_a = 0.05 \mu\text{m}$)
continuous sliding
duration : 24 hrs
sliding velocity : 0.2 m/s or 1 m/s
contact pressure: 2 MPa
air (40% r.h.), vacuum 10^{-5} mbar



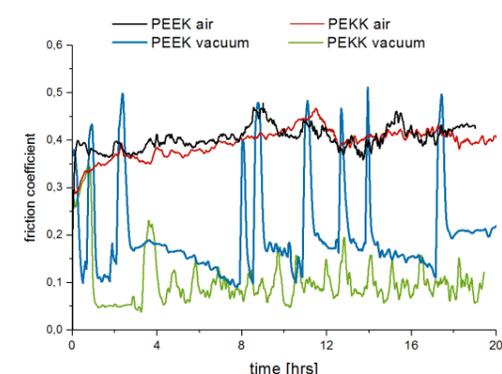
Results



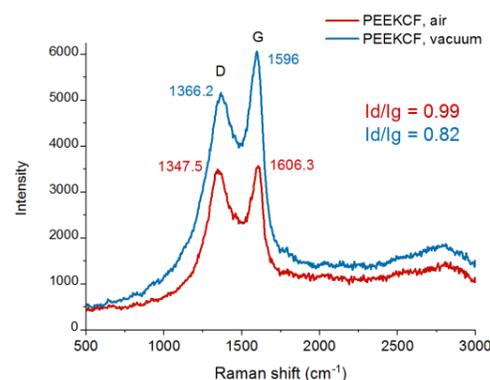
Friction and wear rate of PEEK and PEKK materials at 0.2 m/s :
lower friction in vacuum; severe wear for PEKKCF in vacuum



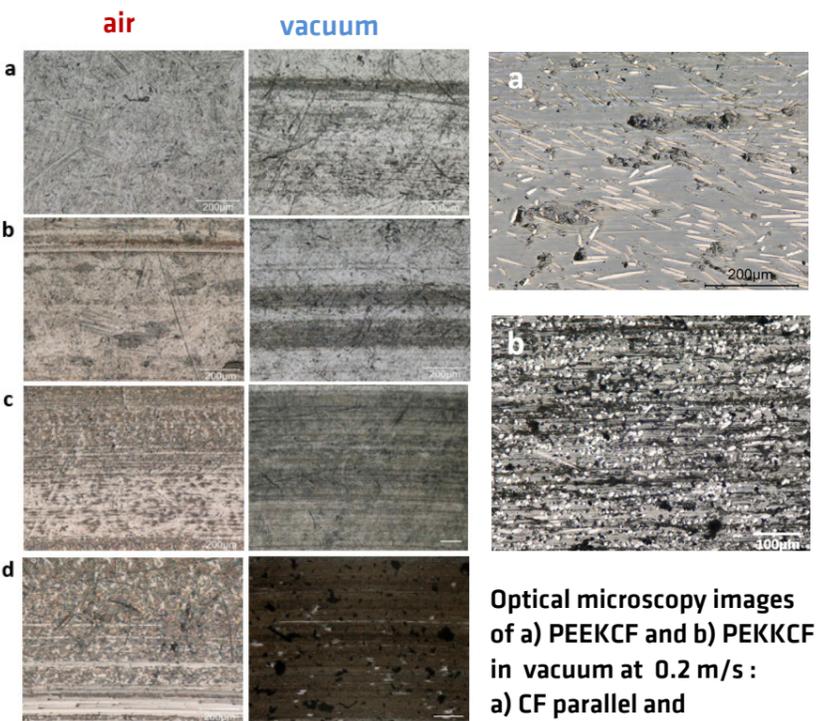
Friction and wear of PEEK and PEKK materials at 1 m/s :
severe wear rate and failure at 1m/s in vacuum



Friction behavior of PEEK and PEKK at 1 m/s :
PEKK is more stable than PEEK in vacuum

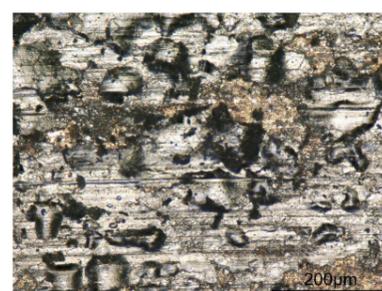


Raman spectra of PEEKCF indicate
higher degree of graphitization in
vacuum



Optical microscopy images of the steel
disks running at 0.2 m/s against
a) PEEK, b) PEKK, c) PEEKCF and
d) PEKKCF

Optical microscopy images
of a) PEEKCF and b) PEKKCF
in vacuum at 0.2 m/s :
a) CF parallel and
b) CF normal
to sliding direction



Optical microscopy images of
the PEEKCF wear debris after
test at 1m/s in vacuum



Self ignition of wear debris
after opening the vacuum
chamber

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