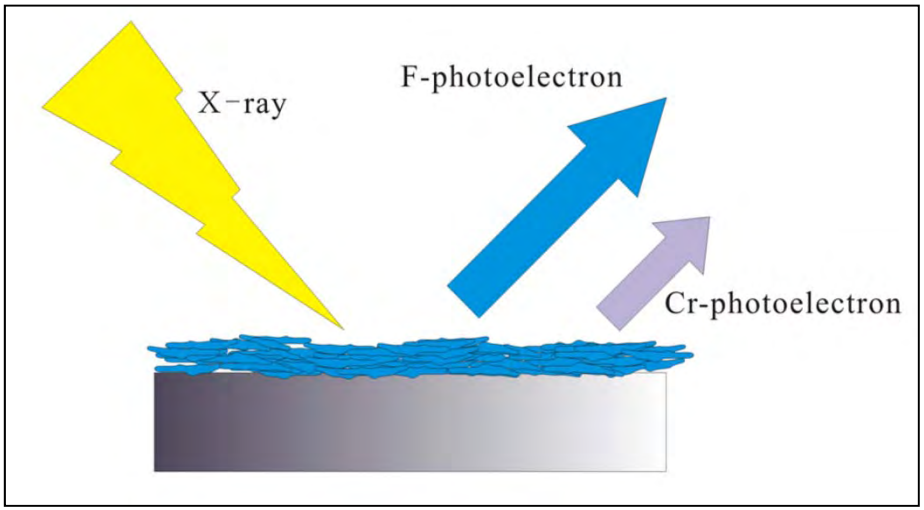
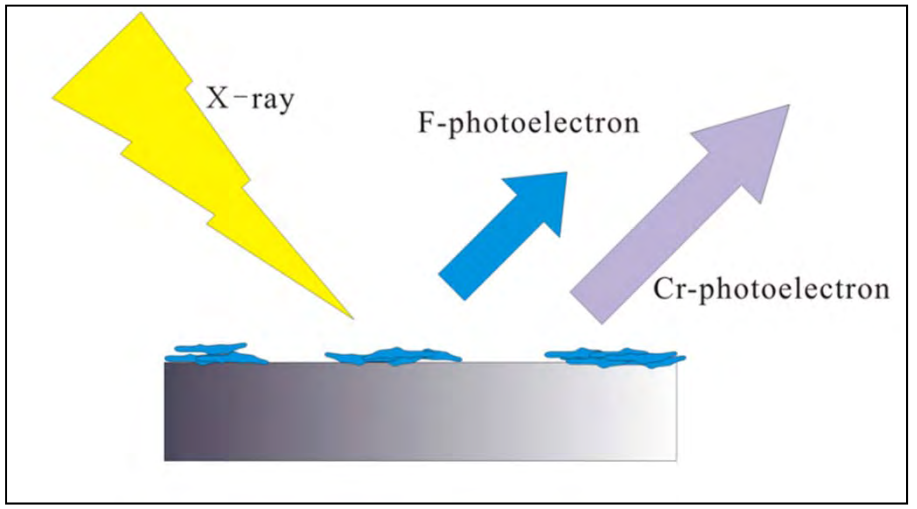
表面分析による転移膜形成量の評価



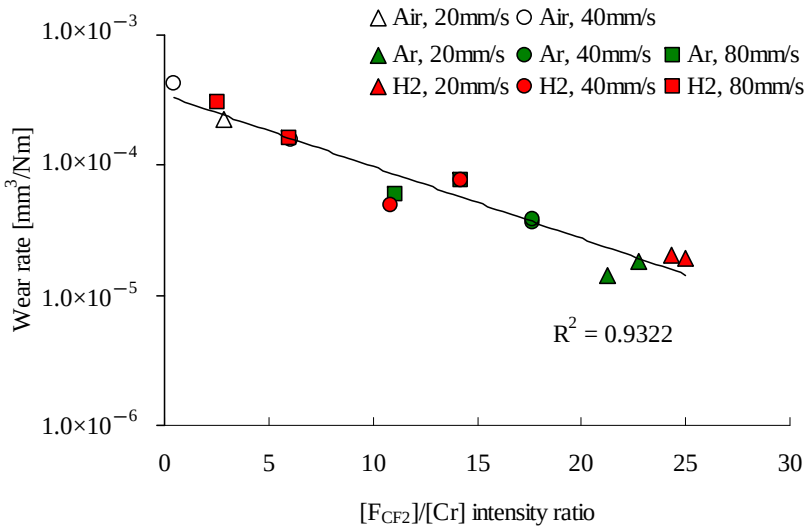
(a) In the case of well developed polymer transfer film



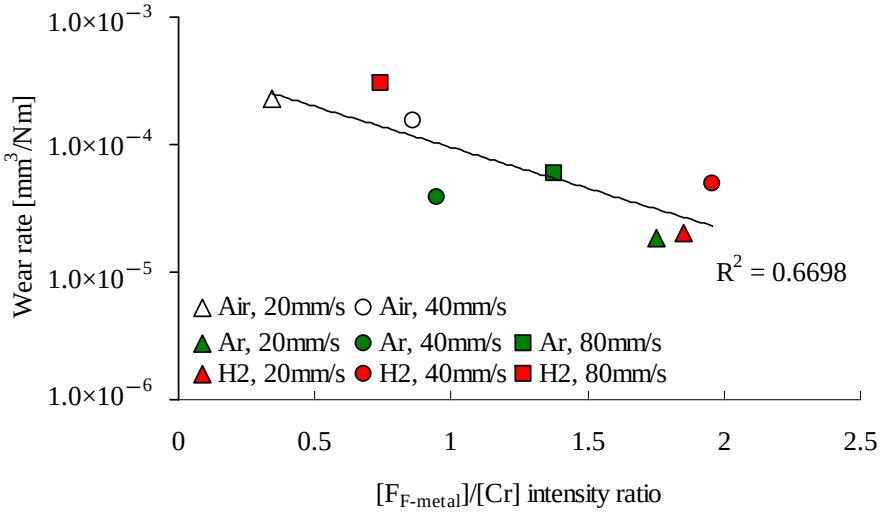
(b) In the case of poorly developed polymer transfer film

- The intensity ratio of $[F_{CF2}] / [Cr]$ was calculated from spectra of the uppermost surface and used to estimate the amount of PTFE adsorbed on the disk surface.
- The intensity ratio of $[F_{F\text{-}metal}] / [Cr]$ was calculated from spectra after 60 s etching to evaluate the amount of metal fluoride formed on the disk surface.

PTFE転移膜形成量と比摩耗量の関係



The wear rate of unfilled PTFE plotted against the amount of PTFE in the transfer film



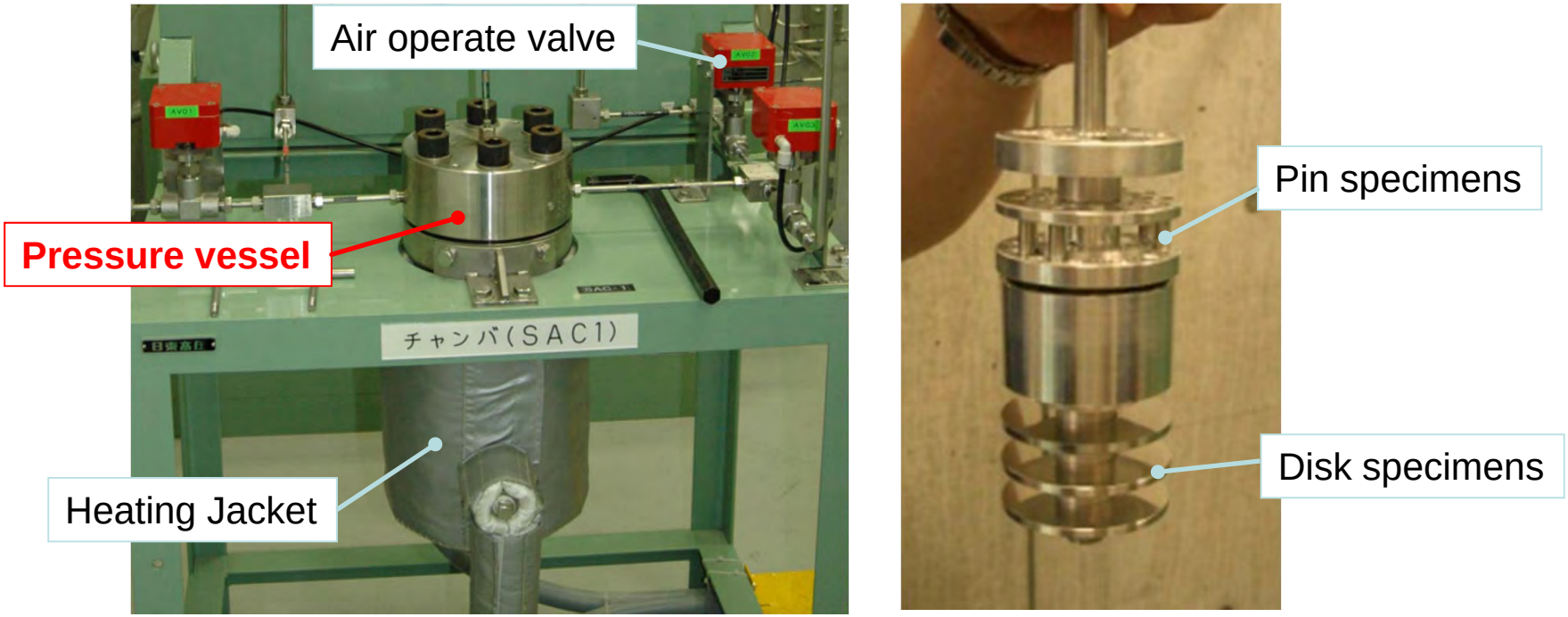
The wear rate of unfilled PTFE plotted against the amount of metal fluoride formed on the disk surface

- The strong correlation could be observed between the specific wear rate of unfilled PTFE and the amount of PTFE transfer film formed on the disk surface.
- The wear rate of unfilled PTFE decreased with increasing the amount of PTFE on the disk surface.
- The wear rate of unfilled PTFE also decreased with increasing the metal fluoride formation.
- The amount of PTFE transfer film in hydrogen was smaller than that in argon in some cases and it might be responsible for the higher PTFE wear rate in hydrogen.

澤江　他：トライボロジスト，54　(2009) 710

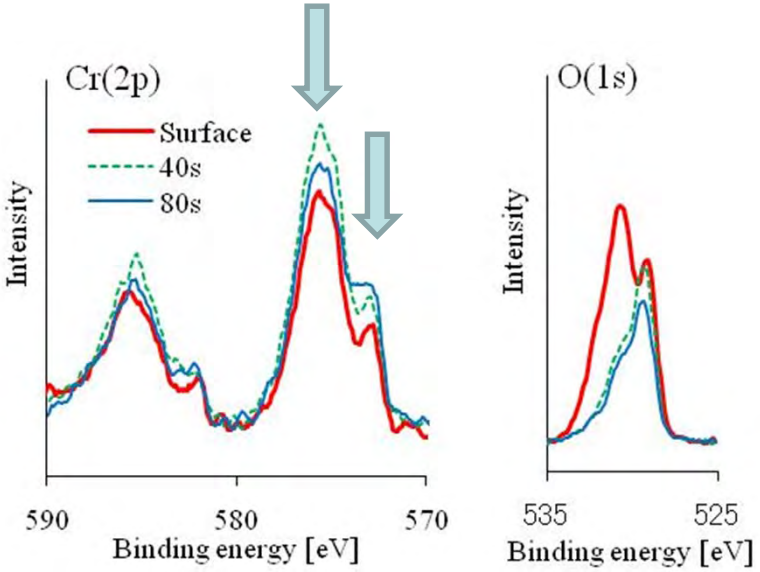
高圧水素ガスに曝露した試験片による摩耗評価

- Effects of high pressure hydrogen on wear behavior of unfilled PTFE were examined by exposing specimens to the high pressure hydrogen gas prior to the wear test.
  - Pin: unfilled PTFE, Disk: SUS316L
  - Gas pressure: 40MPa, Gas temperature: 373K, Exposure period: 200h

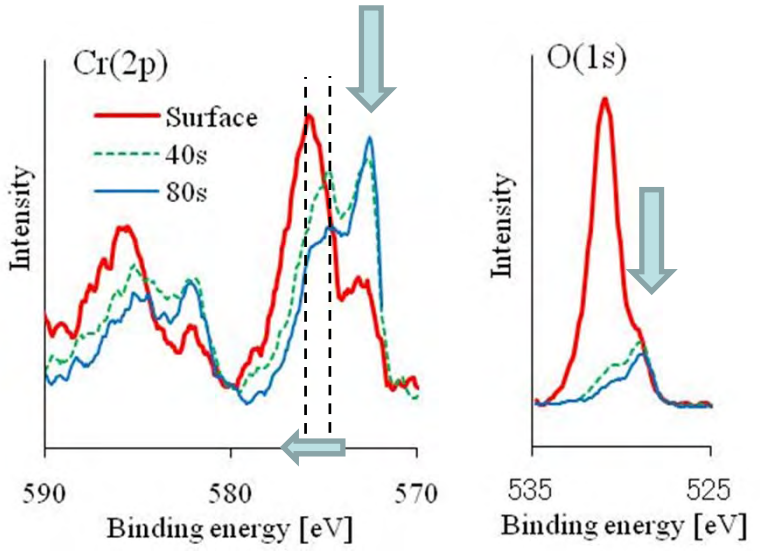


High pressure vessel and specimen holder for specimen pre-exposure to the high pressure hydrogen gas

ステンレス表面の化学組成に対する高圧水素の影響



(a) XPS spectra from unexposed AISI316L

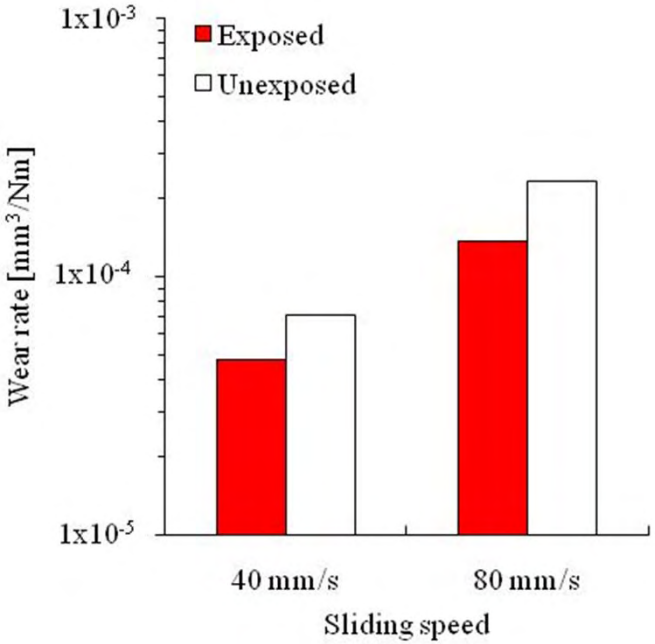


(b) XPS spectra from exposed AISI316L

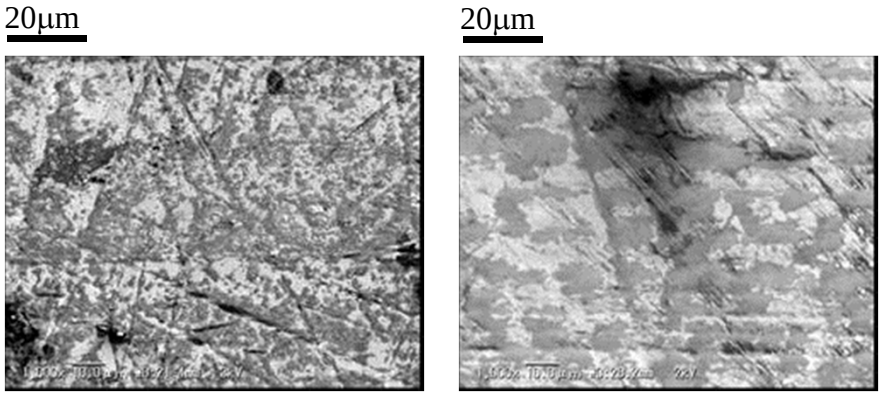
- Cr(2p) spectrum from the unexposed disk surface had a strong peak around 575 eV which related to chromium oxides and the signal from metal chromium was week.
- The peak intensity of metal chromium at 573 eV became significant in the Cr(2p) spectrum of the exposed stainless disk.
- Chromium oxides in the surface passive layer of stainless steel could be reduced.
- Fraction of chromium hydride increased in the uppermost surface of AISI316L.

Nakashima, et al., Proc. IMechE, 224 Part J (2009) 285

無充てんPTFEの摩耗に対する高圧水素曝露の影響



Wear rate of unfilled PTFE under contact pressure of 4 MPa



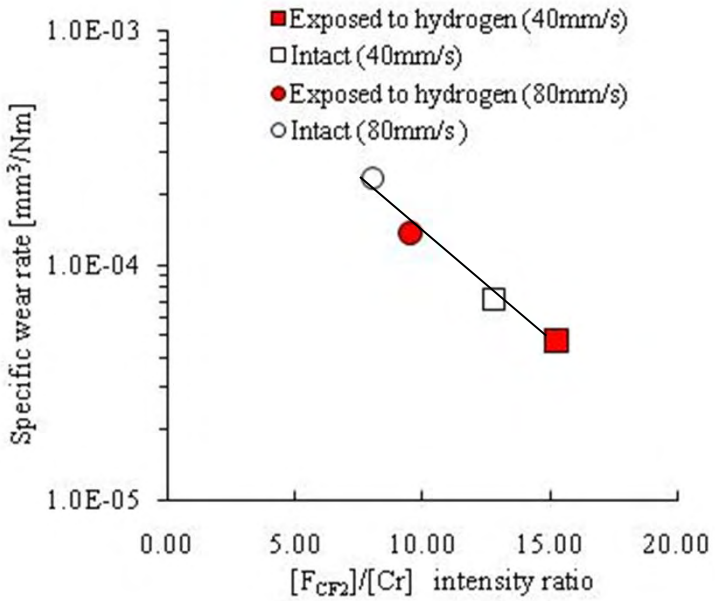
(a) Unexposed specimen (b) Exposed specimen

SEM image of PTFE transfer film formed on the disk specimen during sliding test under contact pressure of 4MPa and sliding speed of 40mm/s.

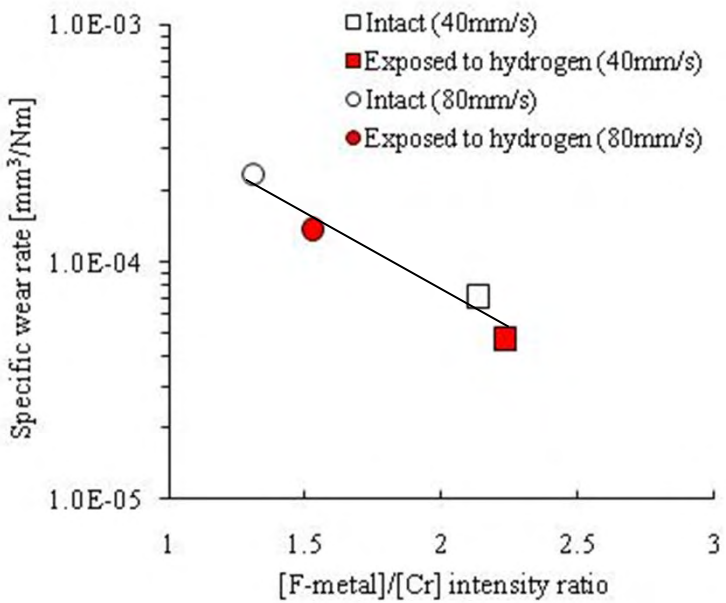
- Specific wear rate of unfilled PTFE was reduced by exposing specimens to high pressure hydrogen gas under all test conditions.
- PTFE transfer film became smoother and more homogeneous by exposing specimens to high pressure hydrogen gas

Nakashima, et al., Proc. IMechE, 224 Part J (2009) 285

高圧水素に曝露した無充てんPTFEにおける転移膜形成量と比摩耗量の関係



Wear rate of unfilled PTFE plotted against amount of CF_2 in the transfer film



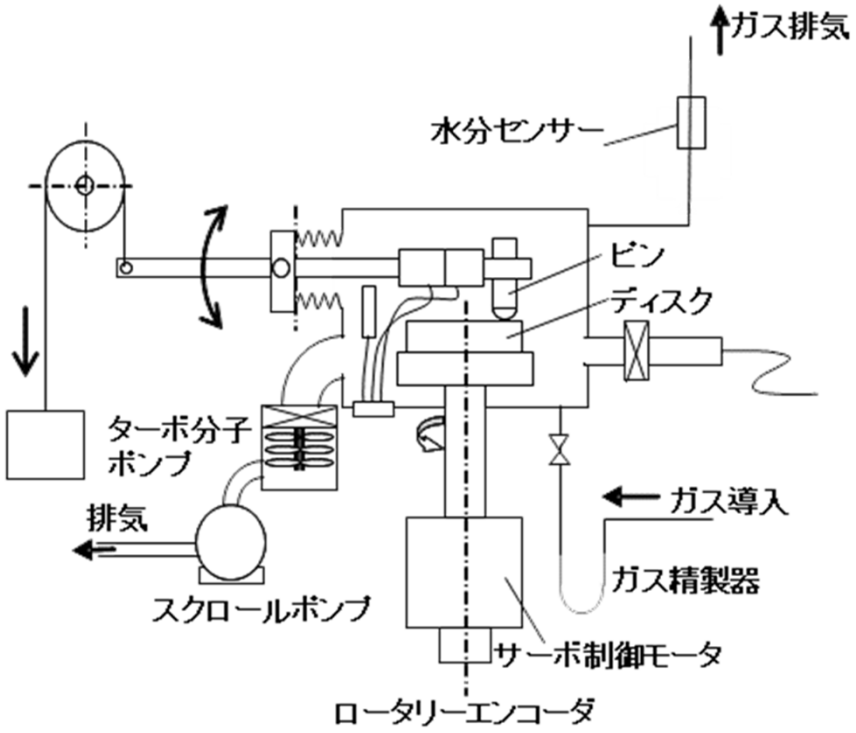
Relationship between wear rate of unfilled PTFE and amount of metal fluoride formed on the disk surface

- PTFE specific wear rate was decreased with increasing both intensity ratios.
- The accelerated PTFE transfer film formation by the exposure to high pressure hydrogen gas would reduce the wear rate of unfilled PTFE.

Nakashima, et al., Proc. IMechE, 224 Part J (2009) 285

高度雰囲気制御摩擦試験機

- ピン･オン･ディスク型摩擦･摩耗試験機
  ＋　高度雰囲気制御チャンバー
  - チャンバー内を5.0×10^{-4} Pa まで真空排気し，残存酸素および水分量を抑制
  - 高純度水素ガス(99.999 %)をチャンバーに充てん．必要によりフィルターにより水分および酸素を除去
  - 試験中のチャンバーに100 ml/min で水素ガスを供給することでガス純度を維持
  - 排気水素ガスの露点を計測し，含有水分量が5ppm 以下であることを確認
  - 不純物の少ない高純度ガス雰囲気において摩擦･摩耗を評価

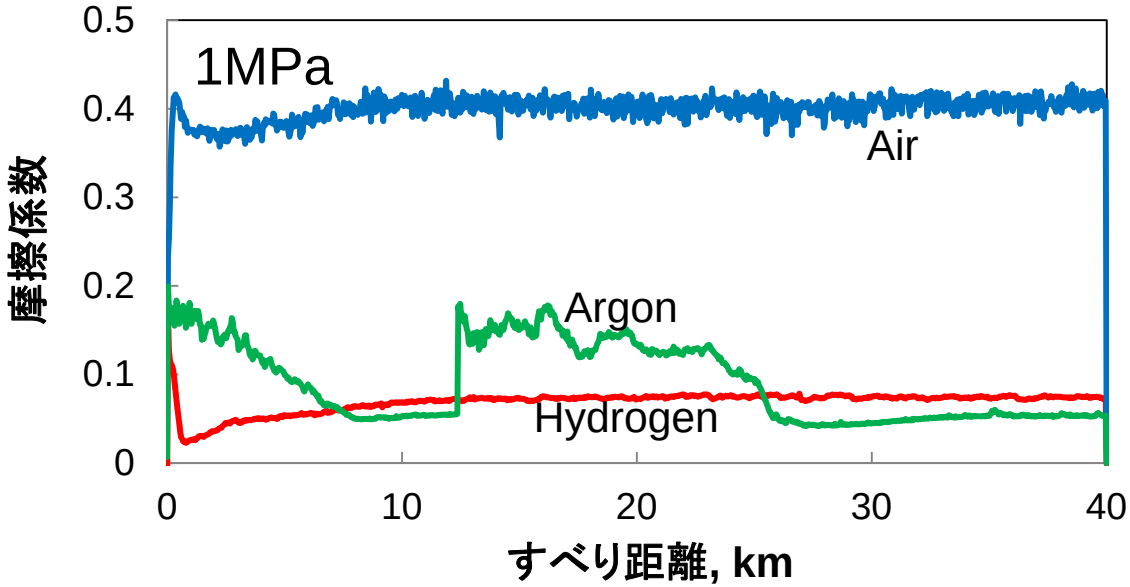


構成概略図

炭素繊維充てんPTFEの摩擦・摩耗評価

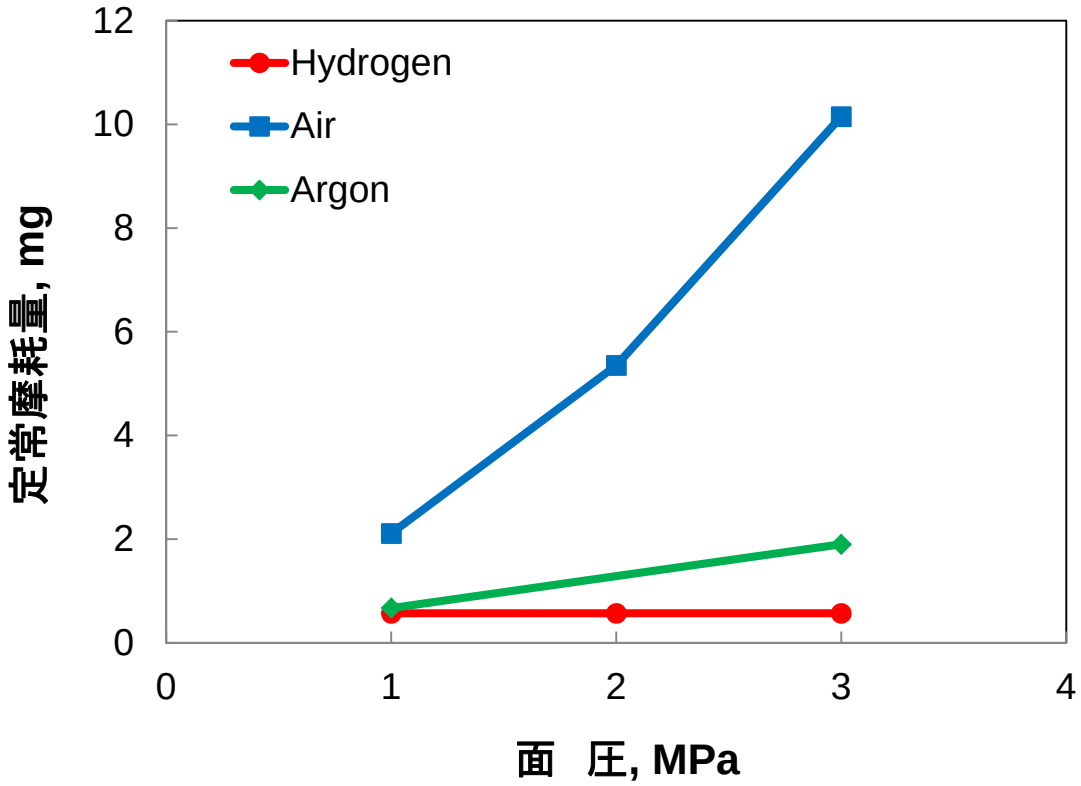
- ピン試験片：１５%炭素繊維充てんPTFE
- 相手ディスク試験片：SUS440C 表面あらさRa0.05μm，硬さHv716
- 雰囲気：水素中（1.5～10ppmH_2O、0.2～3ppmO_2）
  空気中（1～100ppmH_2O）
  アルゴン中（0.5～3ppmH_2O、0.1～0.3ppmO_2）
- 面　圧：1MPa、2MPa、3MPa
- すべり速度：2m/s
- すべり距離：1000, 4000, 10000, 40000m、Total 55000m

摩擦挙動の比較



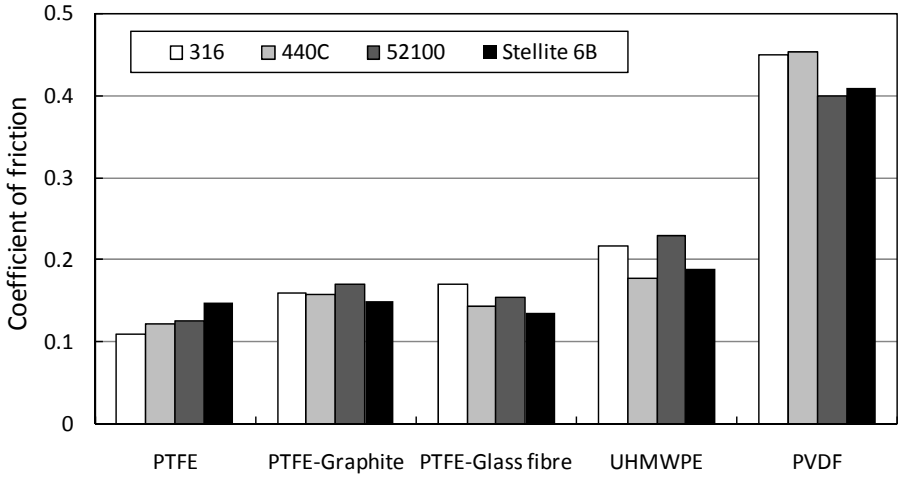
岡田　他., トライボロジー会議2013　秋　福岡　予稿集

比摩耗量の比較

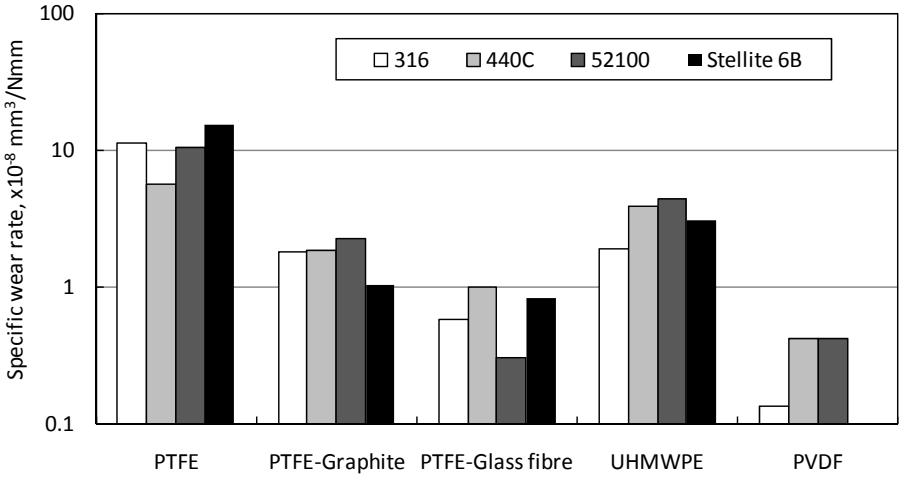


岡田　他., トライボロジー会議2013　秋　福岡　予稿集

高分子シール材の摩擦･摩耗に対する相手面材質の影響



Comparison of friction coefficient in the steady state (in the last 1000 cycles)



Comparison of wear rate in the steady state (in the last 1000 cycles)

- Both friction coefficient and wear rate depend primarily on the kind of polymer materials but also on the mating materials.

Morita, et al., Proc. 21st International Conference on Fluid Sealing, (2011) 167