

Yoshiyuki MIZUTANI

TOYOTA Central Research & Development Labs. Inc.

1. Background

L1 Parts and elements related with tribology in automobile (see Fig.1)

L2 Recent needs for tribological research in automobile

Save energy!

reduce friction loss	
increase life time	→ reduce wear
higher efficiency	→ increase friction without judder
	→ decrease weight → light materials

→ surface modifications

2. Coatings as surface modification for tribology in automobile (see Table 1)

plating, spraying, cladding, PVD, CVD, etc.

3. Topics of coatings and their tribological properties

I : New Cu based alloy for engine valve seat directly deposited onto aluminum cylinder head by laser cladding process

II : Sprayed coating as abrasible seal for turbocharger housing

4. Examples of other applications

- CrN ion plating on piston ring surface      — wear resistance
- Polymer coating on piston surface      — low friction
- Ni-P alloy plating on cylinder bore surface      — wear resistance
- Polymer coating on multi-disc clutches of LSD      — high friction &  $d\mu/dv > 0$

5. Requirements for future developments

- Material design concept
- Peeling resistance
- Standardization of evaluating methods
- Cost down
- Care for environment
- Care for recycling

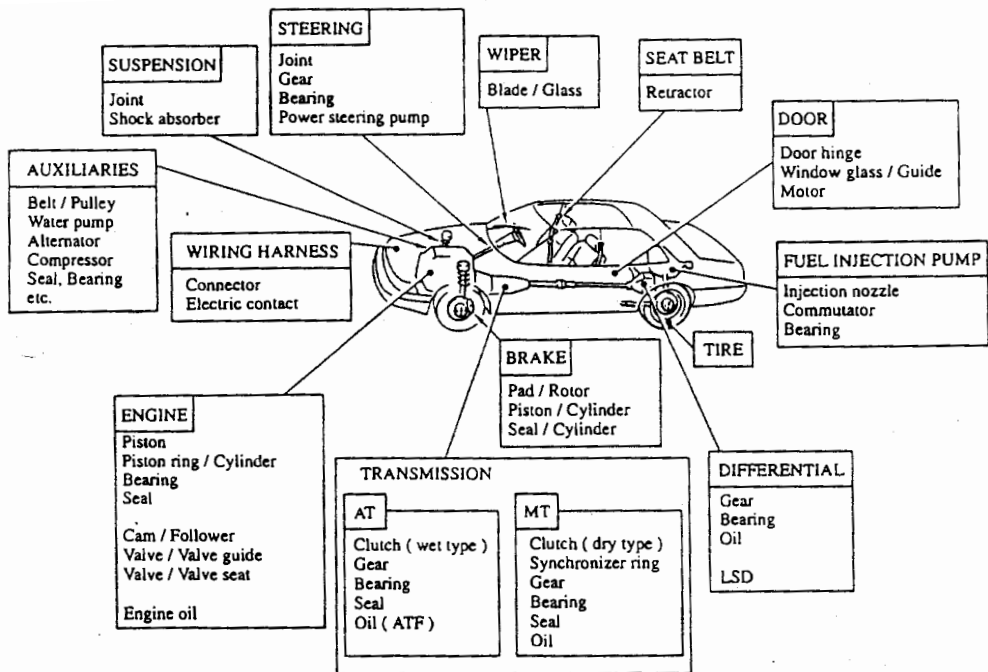


Fig.1. Parts and elements related with tribology in automobile

Table 1 Coatings for tribological applications in automobile

Coatings		Applications	Objective
Plating	Sn	Piston	running-in
	Cr	Piston ring, Absorber rod, Piston pin	wear-resistance
	Ni-P, Fe-P	Piston	wear-resistance
	Ni-B	Air compressor vane	wear-resistance
	Ni-SiC	Rotor housing	wear-resistance
	Ni-P-SiC	Cylinder block, Liner, Piston ring	wear-resistance
	Ni-Co-P-Si <sub>3</sub> N <sub>4</sub>	Piston ring	anti-suffing
Polymer coatings	MoS <sub>2</sub> -Resin	Piston	low friction
	CF-MoS <sub>2</sub> -Resin	LSD friction plates	high friction
	Polyamide	Drive shaft, Telescopic steering	min. clearance to reduce slapping noise
Spraying	Fe-C	Valve lifter	wear-resistance
	Al-Si-Polyester	Turbocharger housing	min. clearance to reduce gas leakage
Cladding	Co-Cr	Engine valve	wear-resistance
	Cu alloy	Valve seat	wear-resistance, anti-suffing
PVD, CVD	TiN, CrN	Piston ring	anti-suffing
			wear-resistance

CF: carbon fiber

LSD: limited slip differentials