

Dry Metal Forming with Coated Tools

- Dry metal forming: the influence to the environment and the cost of manufacturing could be reduced.
- The frictional behavior of some working metals sliding over tool surfaces without lubricant



(a) Cemented tungsten carbide



(b) TiC coated (CVD)



(c) TiN coated (PVD)



(d) TiC+TiCN+TiN coated (CVD)



(e) TiAlN coated (PVD)



(f) DLC coated (Plasma CVD)

Fig. Tungsten carbide tool and coated tools (Tool roughness: $R_a = 0.02-0.04\mu\text{m}$, Film thickness: $2.0-7.0\mu\text{m}$ (DLC: 40nm))

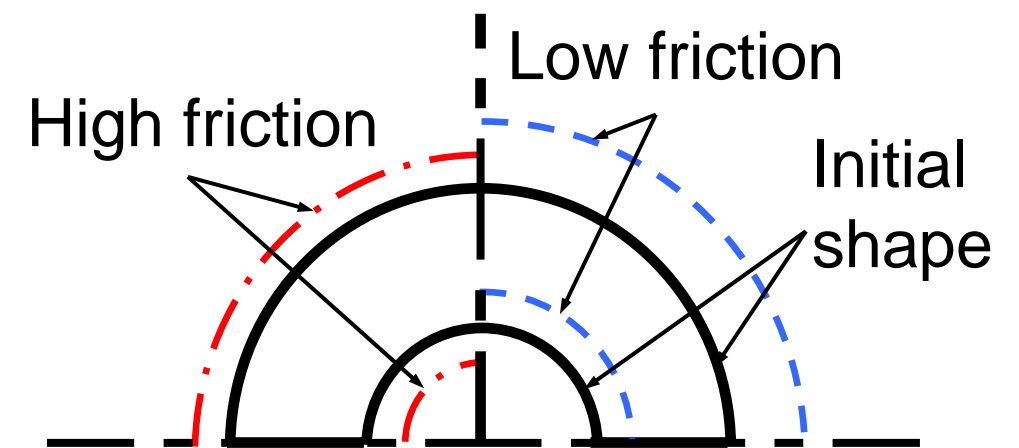
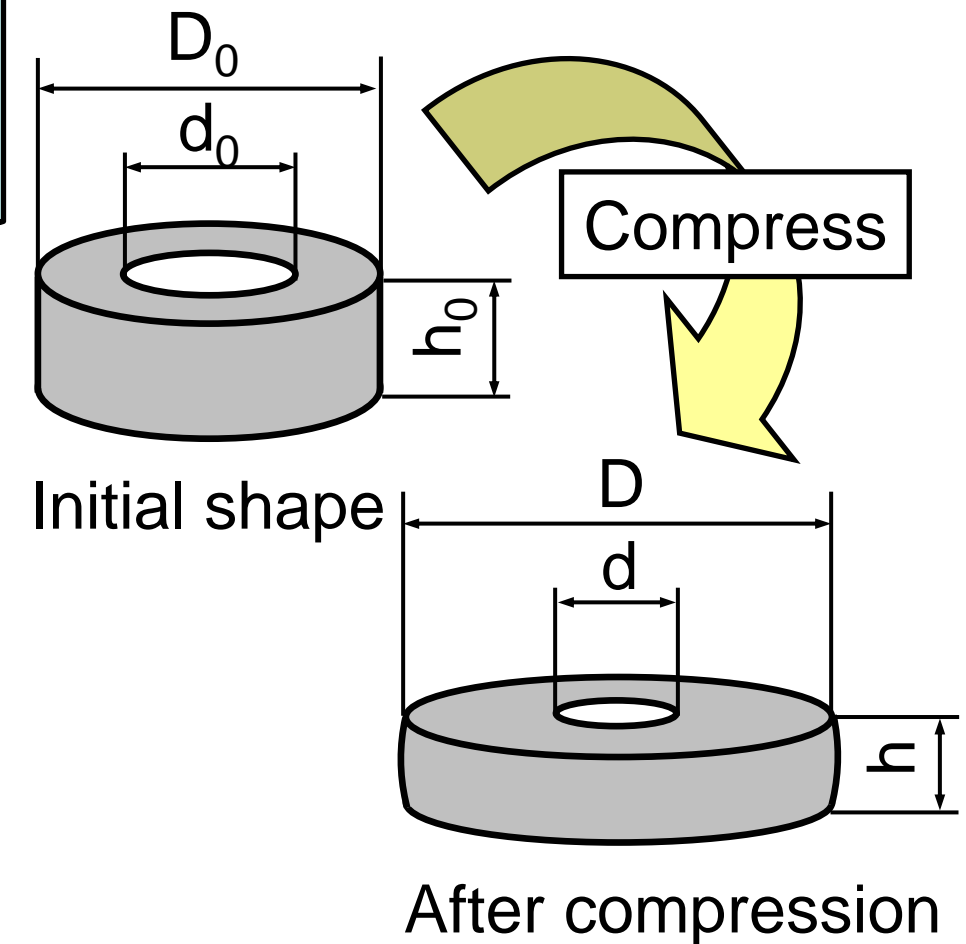


Fig. Deformation of ring specimen during compression

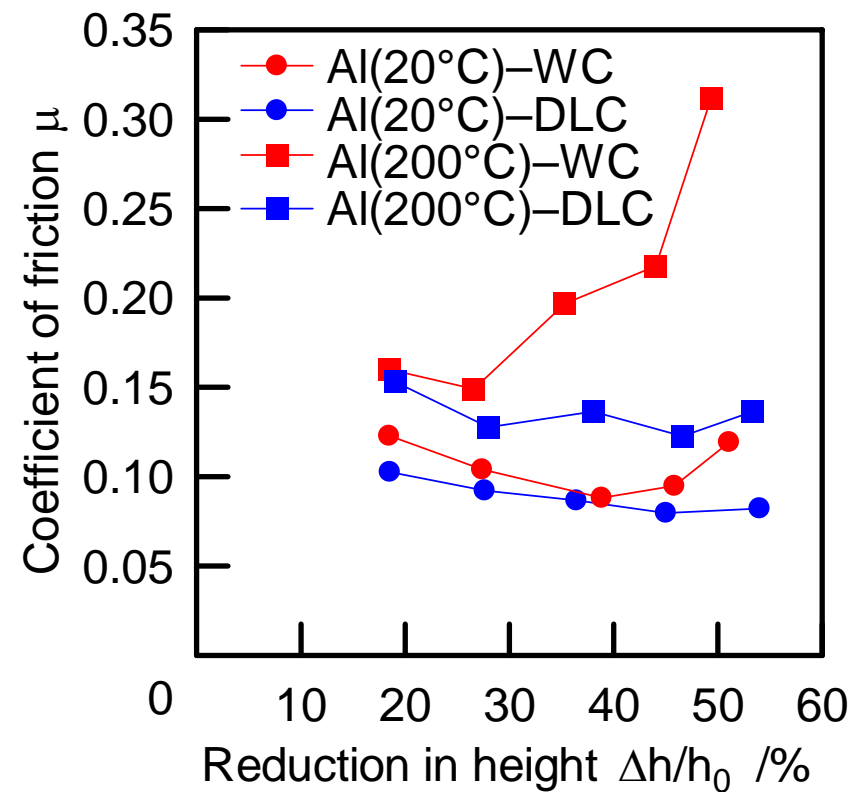
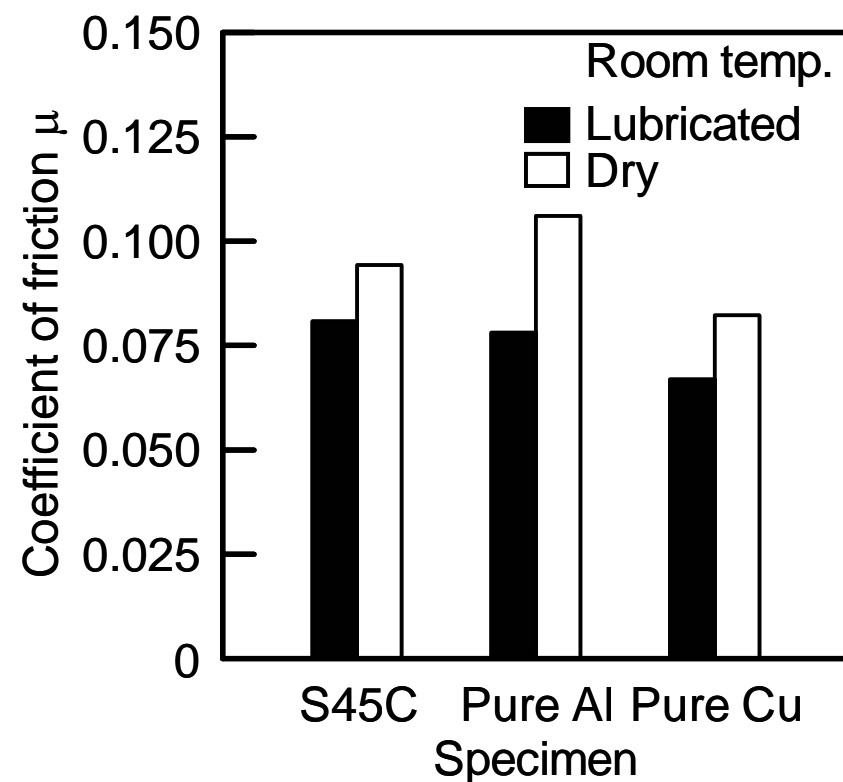
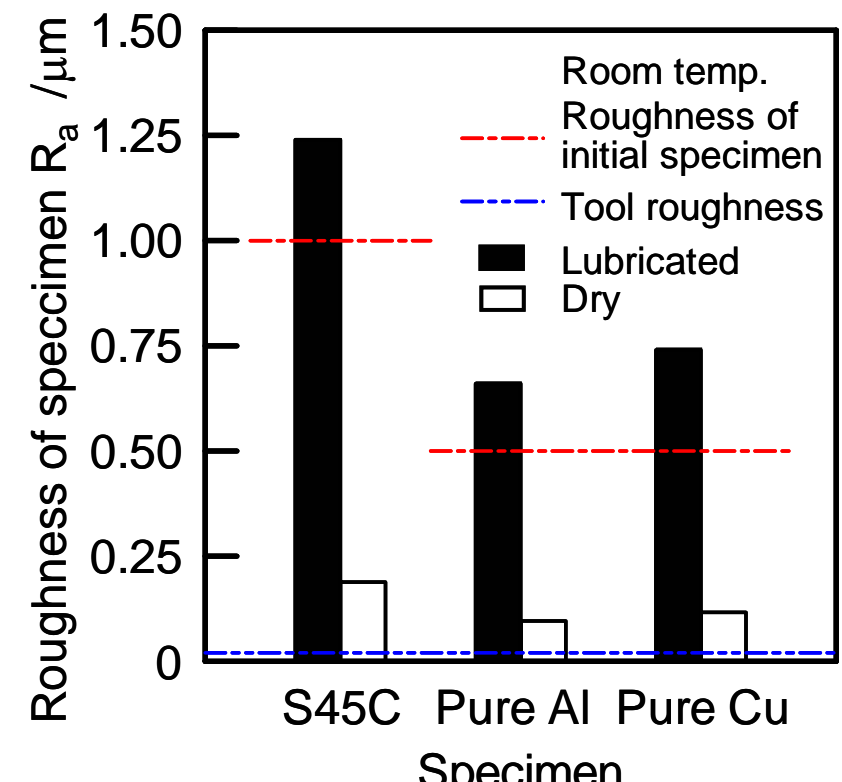


Fig. Effect of reduction in height on friction for aluminum billet sliding over WC and DLC coating



(a) Coefficient of friction



(b) Roughness of specimen after compression

Fig. Comparison with under lubrication and dry conditions (Thickness of lubricant: $1.7\mu\text{m}$)

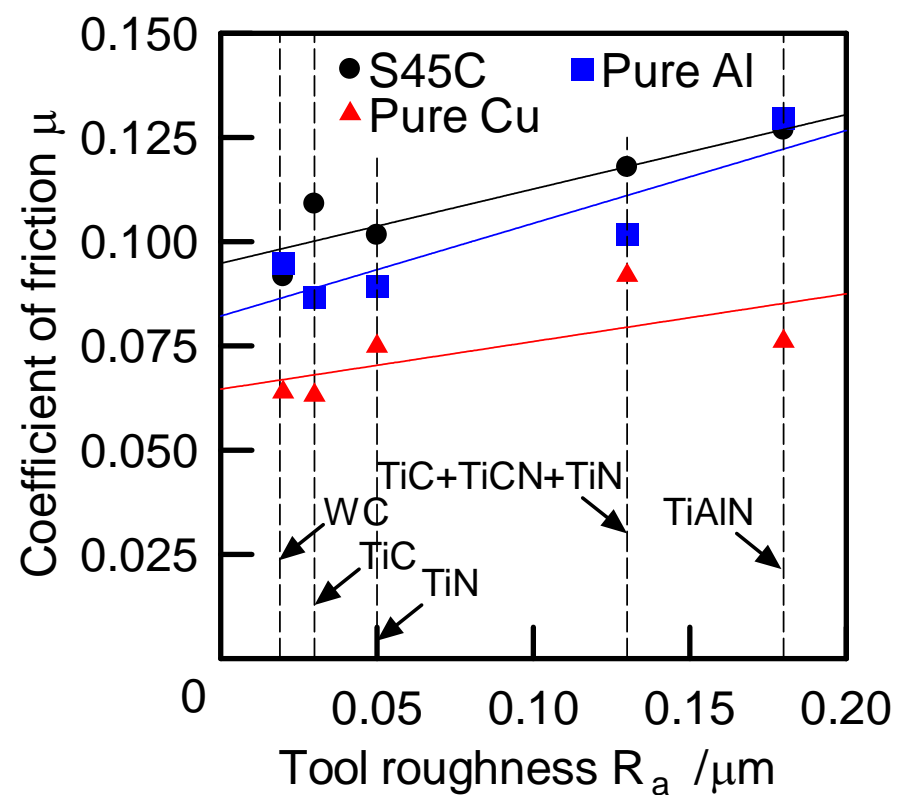


Fig. Effect of tool roughness on friction at room temperature

Conclusions

1. DLC (diamond like carbon) coating results in low friction with aluminum under dry forming condition.
2. The coefficient of friction is sensitively affected by the roughness of tool surface during forming without lubricant.
3. The roughness of specimen after compression is very low under dry condition.