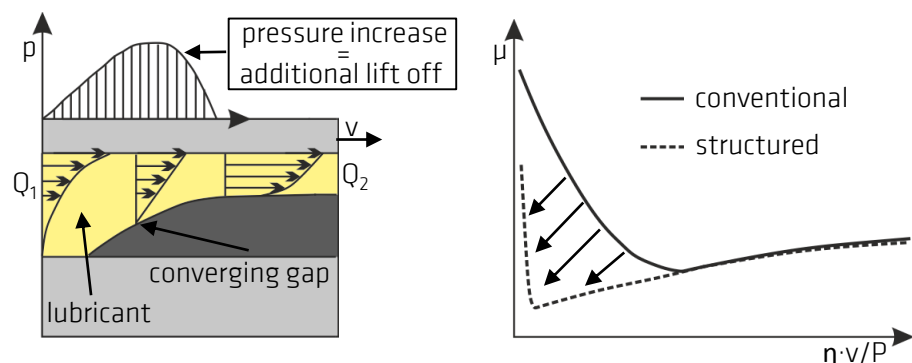


LOCALIZED DISPERSING OF TITANIUM-DI-BORIDE WITH PULSED LASER

Felix Spranger, Kai Hilgenberg

MOTIVATION:

- Elevated structures offer great potential to manipulate a lubricant film or remove wear debris
- The contact area/pressure and thus the coefficient of friction can be adjusted



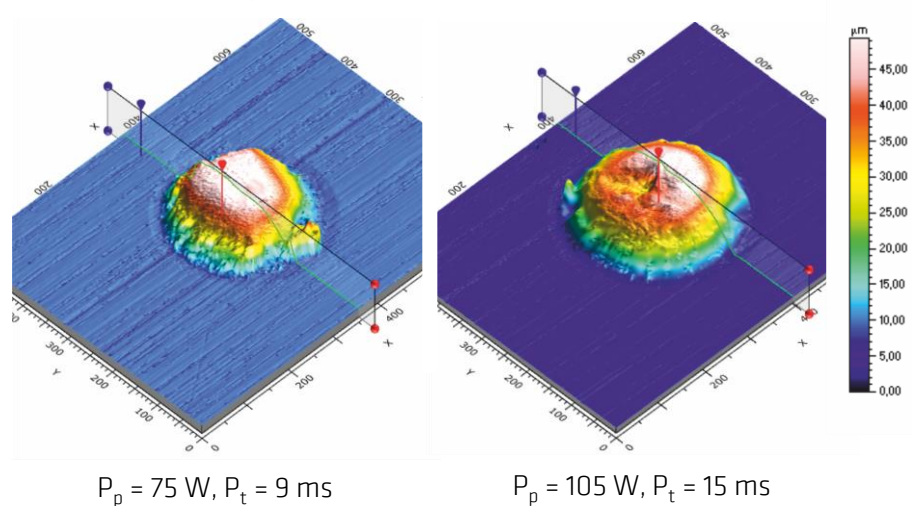
Hydrodynamic lubrication on converging gaps and friction behavior

- Since protruded features are predominantly affected by wear, they are rarely used in industrial applications

➔ A structuring process which enables the formation of elevated structures with a high wear resistance is needed

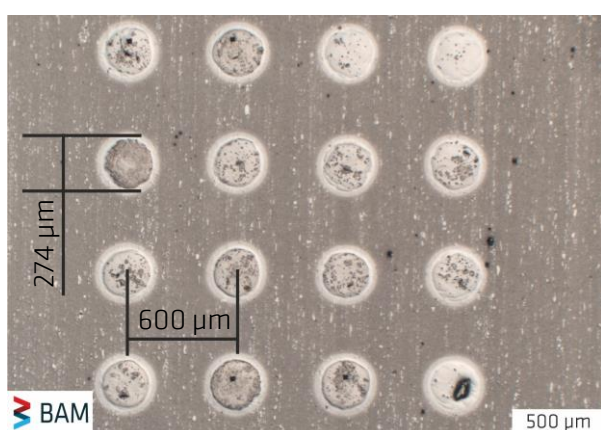
RESULTS:

- Successful generation of separated, dome-shaped spots on cold-work steel due to a volume increase by the distribution of TiB₂-particles within the dispersing zone
- Adjustment of the geometrical parameters height and width by variation of the laser parameters



Dome-shaped elevated spots

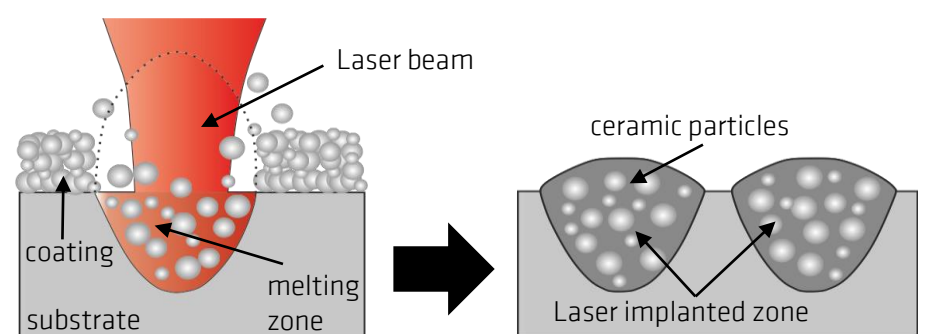
- High reliability of the process and uniformity of the structure geometry
- Flexible arrangement of single separated features on 3d-surfaces



Patterned surface by dome-shaped features in a 4x4 matrix

APPROACH:

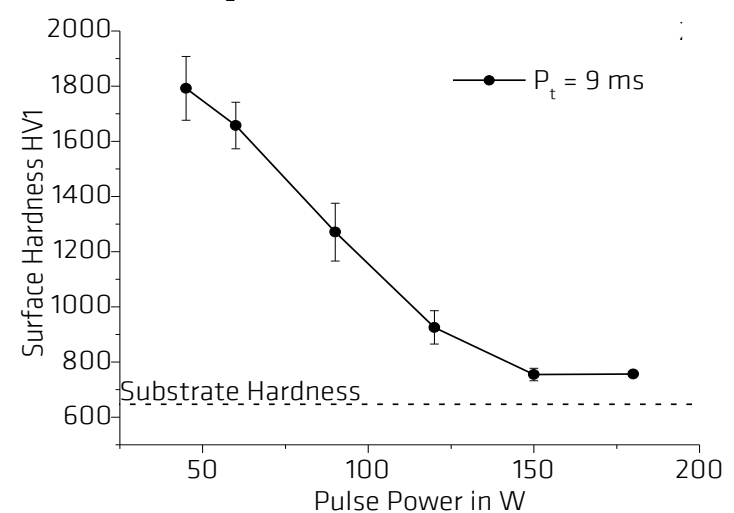
- Manufacturing of separated surface features due to a localized dispersing of TiB₂ by pulsed laser radiation
- Improved wear resistance of the elevated features due to hard particles embedded in a ductile matrix



Laser implantation and protruded surface features

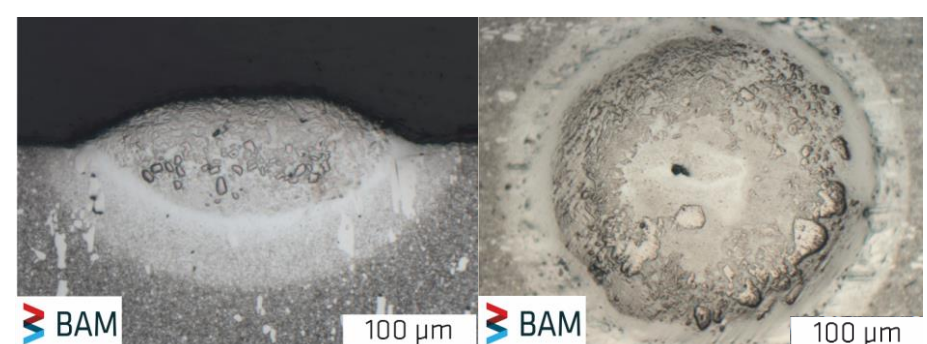
Substrate	X153CrMoV12	tool steel hardened to 646 HV1		
TiB ₂	Hardness [HV1]	T _{melt} [°C]	d ₅₀ [μm]	ρ [g/cm ³]
	3400	2970	3.5-6	4.5

- High abrasive wear resistance of the protruded spots due to hardness values up to 1800 HV1 and in a wide range above 1200 HV1
- High adhesive wear resistance of the localized dispersed zones due to TiB₂ contents up to 60 %



Hardness distribution over laser power and pulse duration

- Good bonding of the TiB₂-particles in a ductile and crack-free matrix
- Application in alternated stressed contact situations due to Metal-Matrix-Composite character



Cross section and top-view of a localized dispersed zone

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