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Direct-write Optical Trap Assisted Microsphere Near-field Nanostructuring with Ultrashort Laser Pulses

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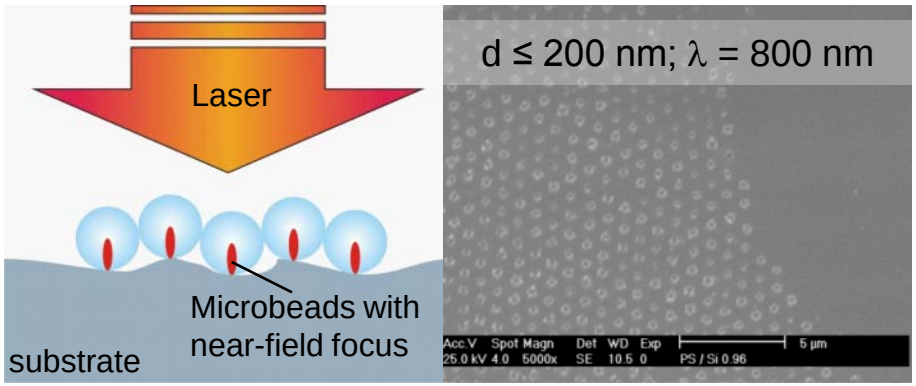
Optical Trap Assisted Nanostructuring

Light cannot be focused smaller than the diffraction limit

- A decrease in feature size is possible by a reduction of the laser wavelength λ
- The minimal laser spot diameter cannot be smaller than λ/2
- Therefore laser structuring cannot generate features below 100 nm

Near-field effects can be utilized to overcome this limitation

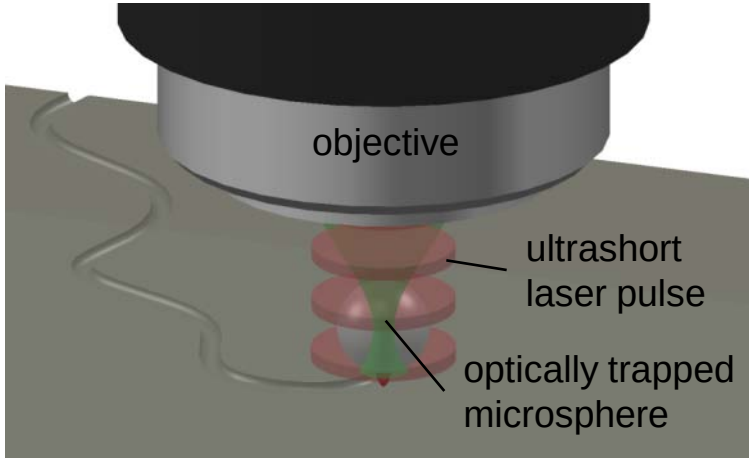


- A monolayer of transparent micro-particles is deposited on a substrate
- The layer is illuminated with pulsed laser radiation
- The particles focus the laser pulses and give rise to optical near-fields
- Large areas can be structured

→ This approach allows for the structuring of features much smaller than the laser wavelength – but only rigid hexagonal patterns can be produced

Optical Trap Assisted Nanostructuring

Direct-write nanostructuring becomes possible by using an optical trap



- Transparent particles can be trapped by a tightly focused cw laser beam
- This can be used to position and move microparticles on a substrate
- A second, pulsed laser illuminates the trapped particle
- An optical near-field is created under the particle which can be used to structure the substrate