

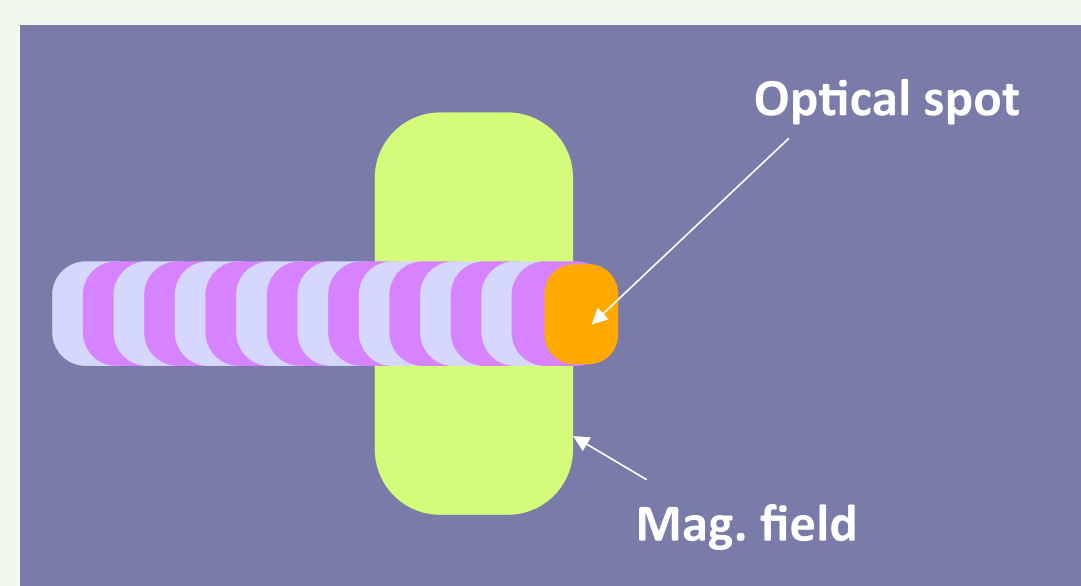
# Heat Assisted Magnetic Recording Media: Progress and Remaining Challenges

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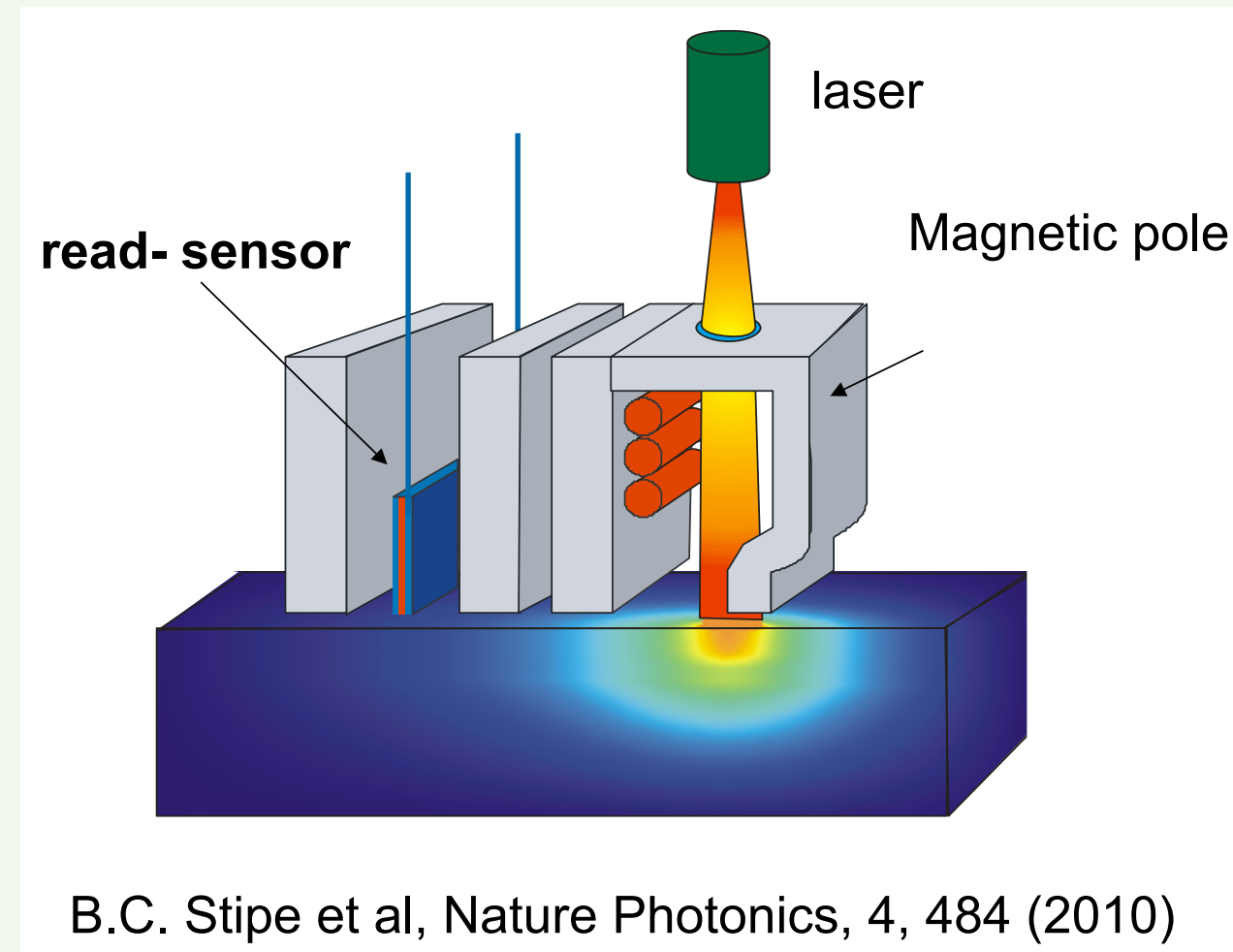
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## IDEA

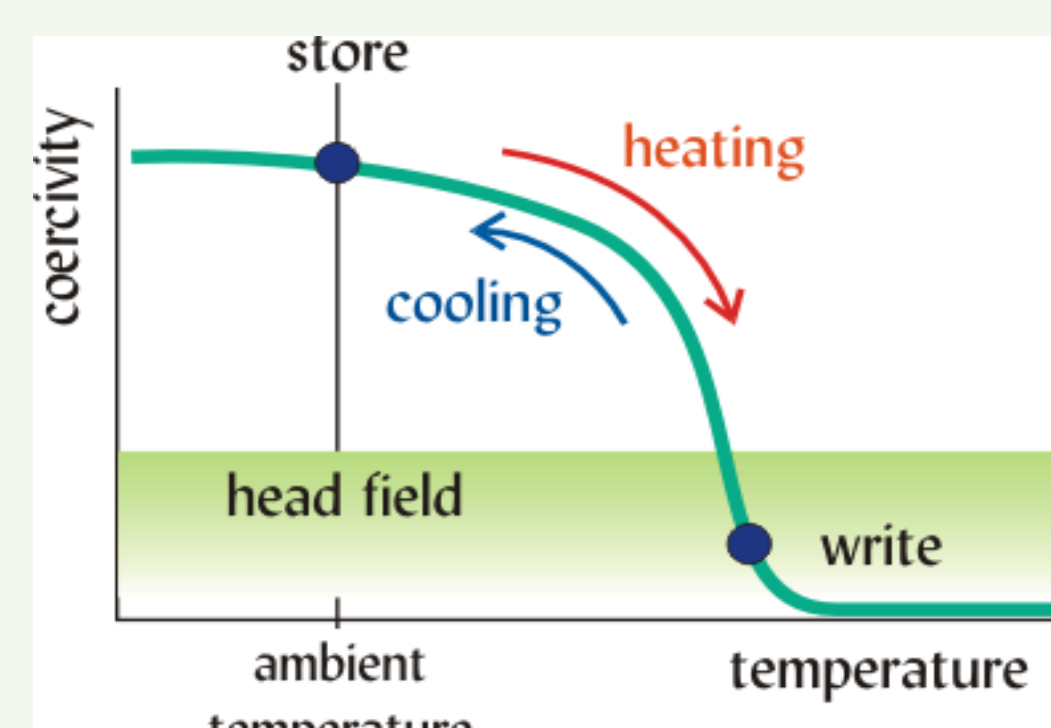
- Use temperature dependence of coercivity to fulfill two conditions simultaneously:
  - High anisotropy  $K_u$  for thermally stable grains and
  - Low coercivity  $H_C$  to be able to write bit transitions using a conventional write head
- Thermal gradient rather than magnetic field gradient determines the position of the bit transitions
- Heat up to write and cool down for storage/readout
- Grain sizes down to 3 nm are thermally stable for  $L1_0$  FePt



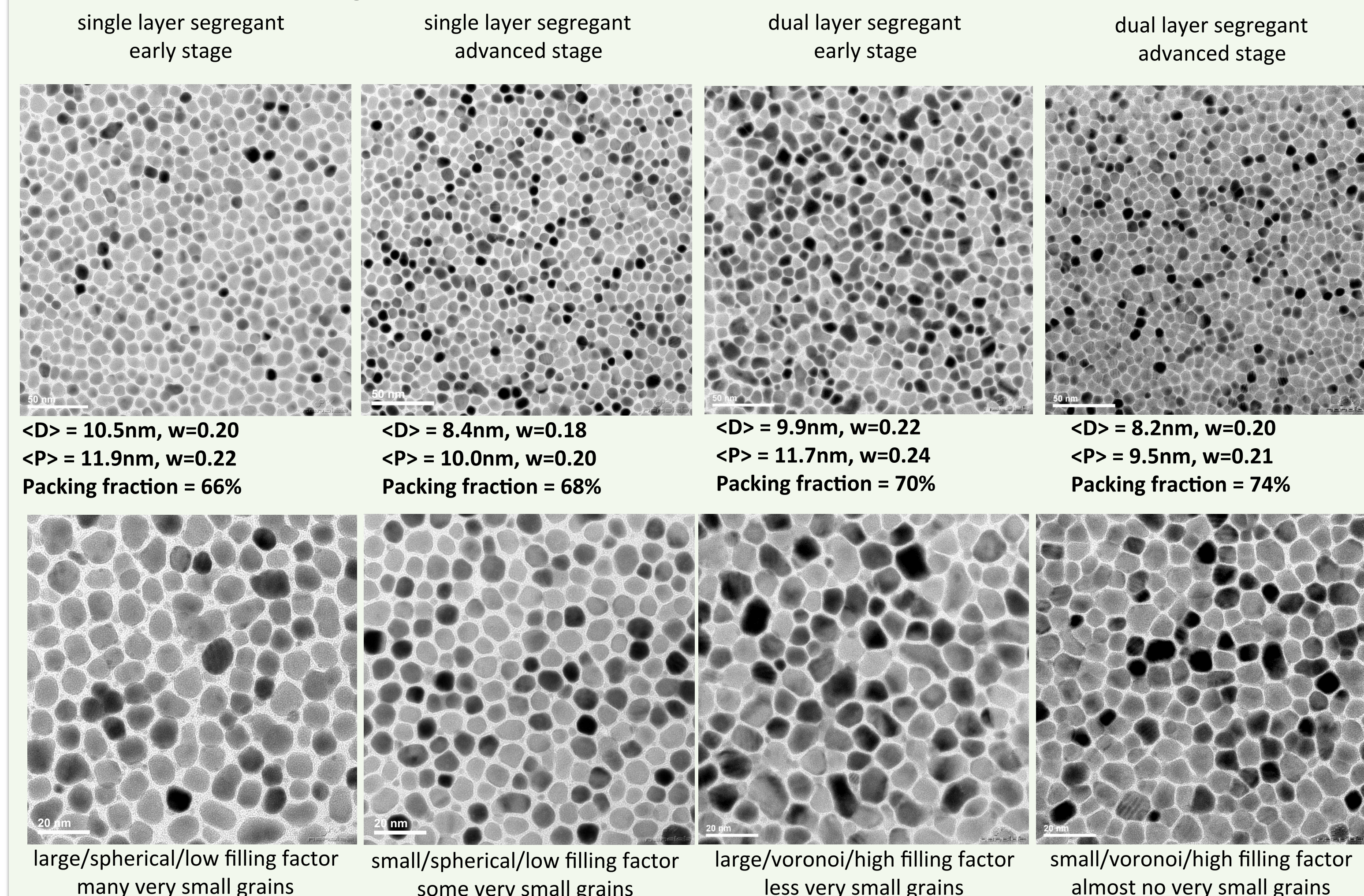
$$\frac{dH_{eff}}{dx} = \frac{dH_k}{dT} \cdot \frac{dT}{dx}$$



B.C. Stipe et al, Nature Photonics, 4, 484 (2010)



## TEM comparison of recent HAMR media flavors



## Challenges for HAMR

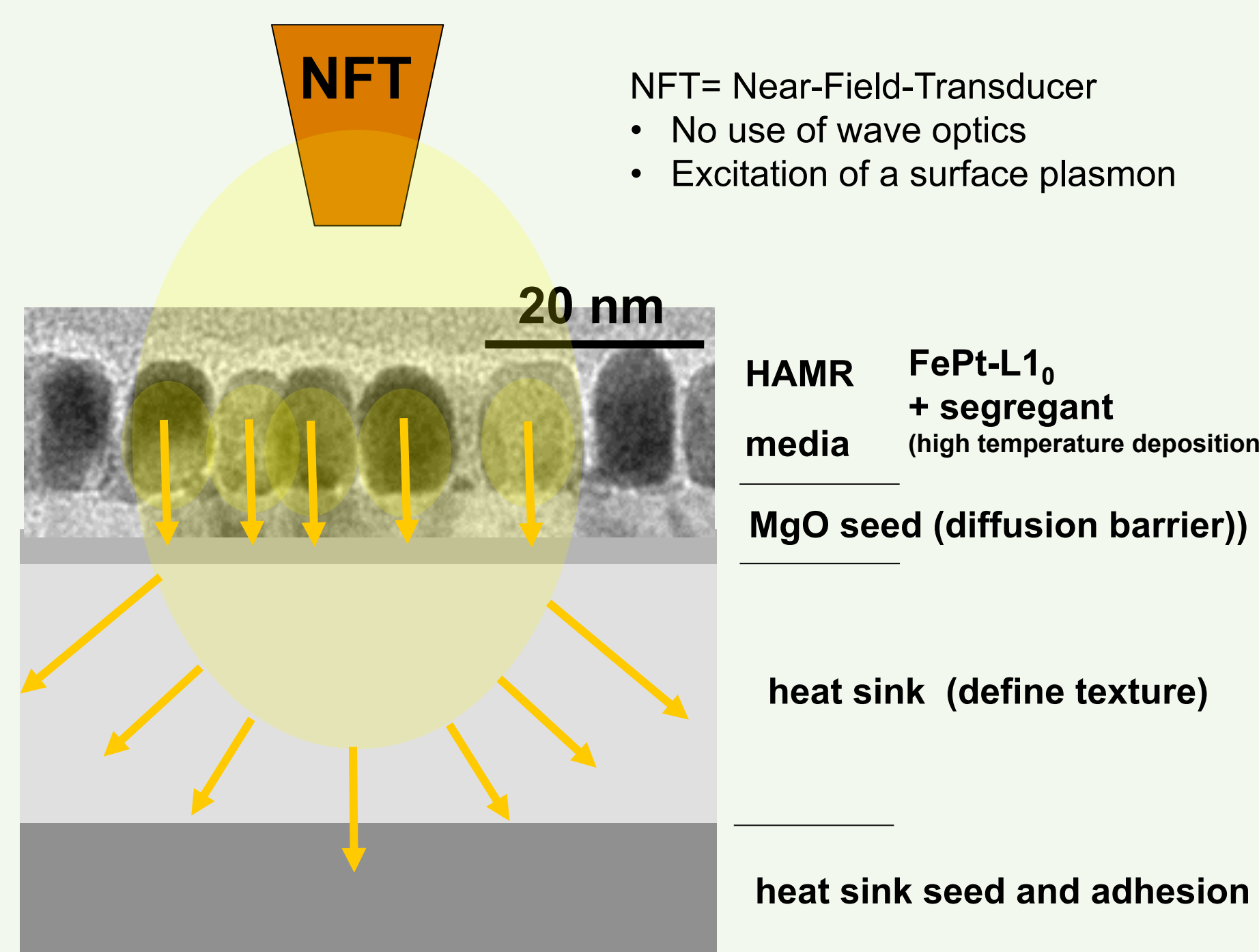
HAMR media are magnetic as well as thermal and optical functional material systems.

Other functions of the HAMR media system that need optimization:

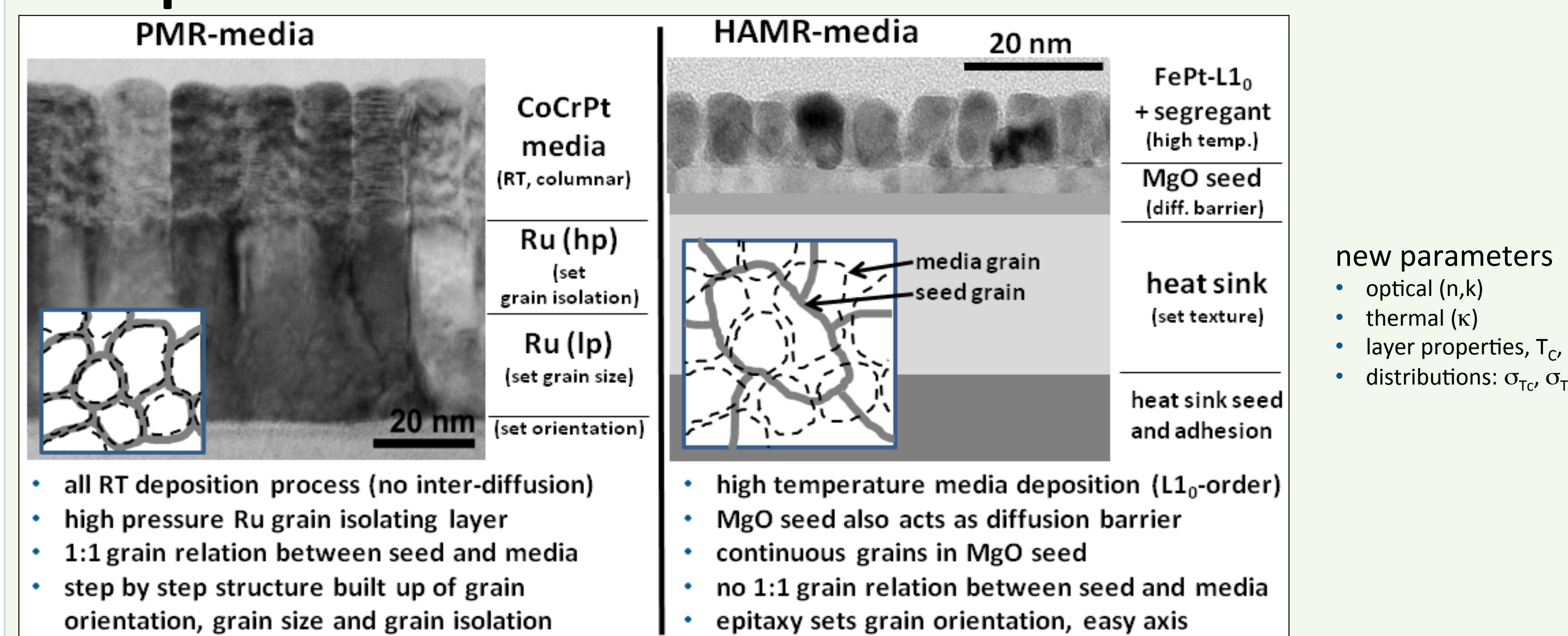
- Granular nanostructure
- Mechanics
- Tribology (particles, surface energy)
- Surface roughness
- Aerodynamics
- Corrosion

### HAMR specific

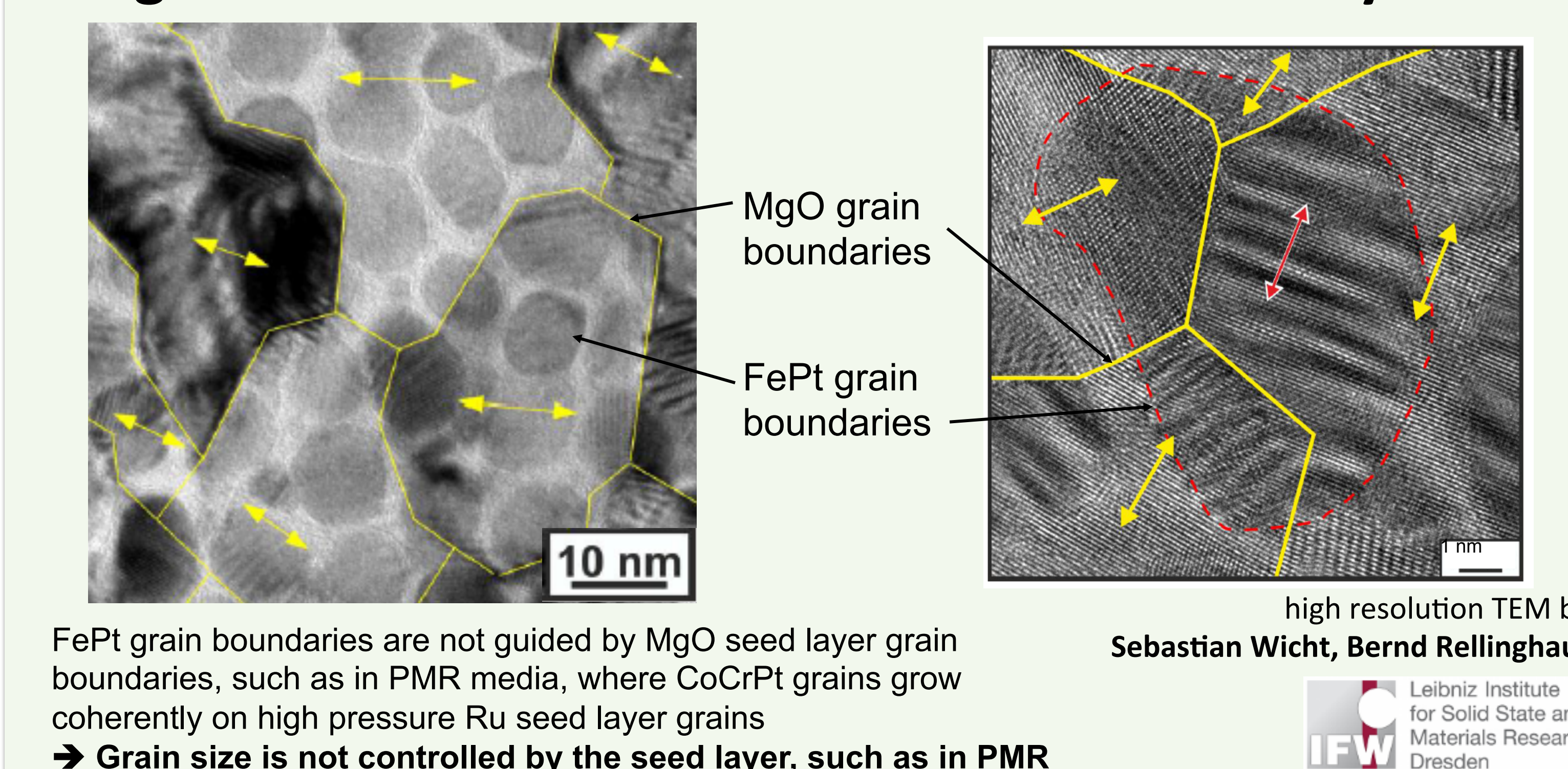
- Optical absorption
- Thermal flux into the "heat sink"
- Laser power reduction
- Lateral thermal gradient ( $\sim 10$  K/nm required)



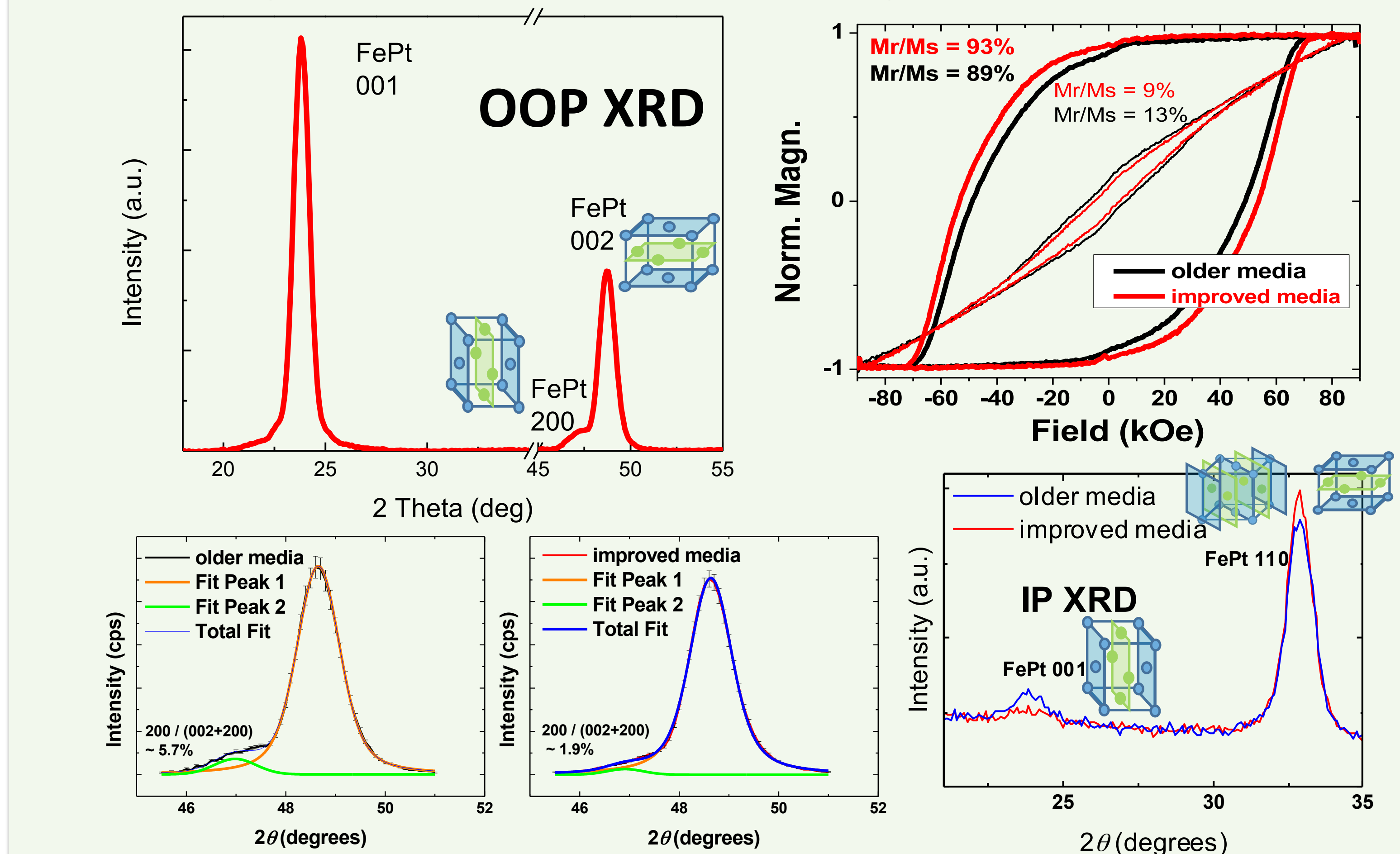
## Comparison: PMR media versus HAMR media



## No grain coherence between seed and media layer



## Quantifying amount of in-plane easy axis grains with XRD and VSM



## Magnetic Property challenges

- avoid misaligned grains
- avoid small grains
- more square out-of-plane loops
- reduce in-plane hysteresis
- improve DC SNR

