SCHOOL of ENGINEERING & APPLIED SCIENCE
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Contributions of electron and phonon transport to the thermal conductivity of GdFeCo and TbFeCo amorphous rare-earth transition metal alloys

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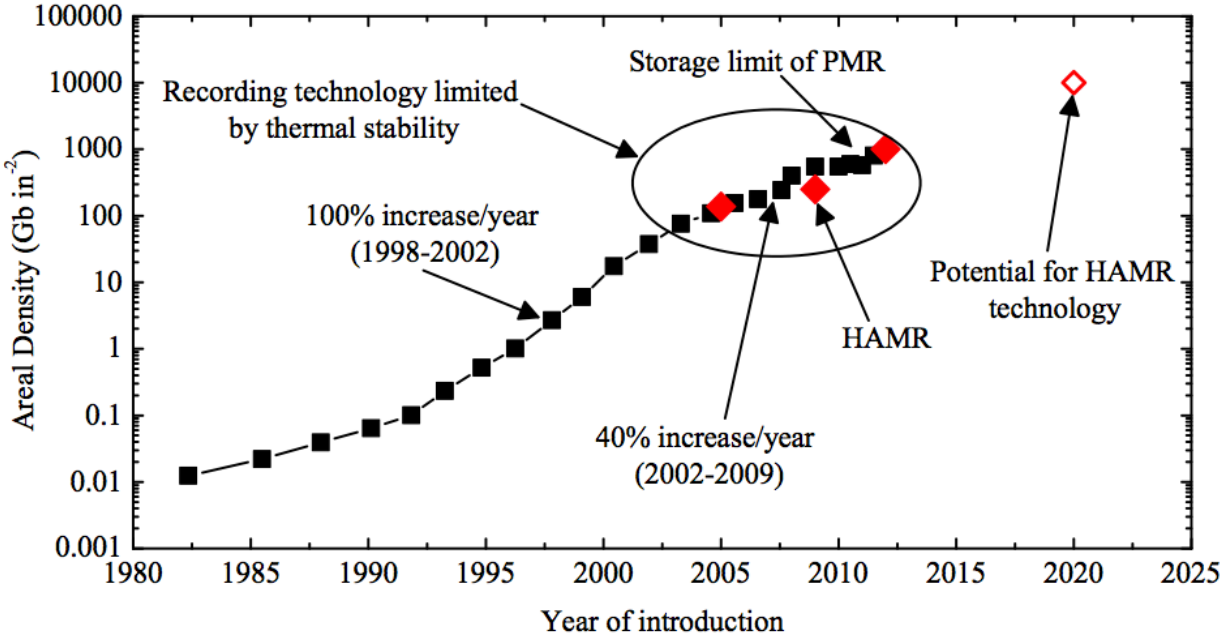
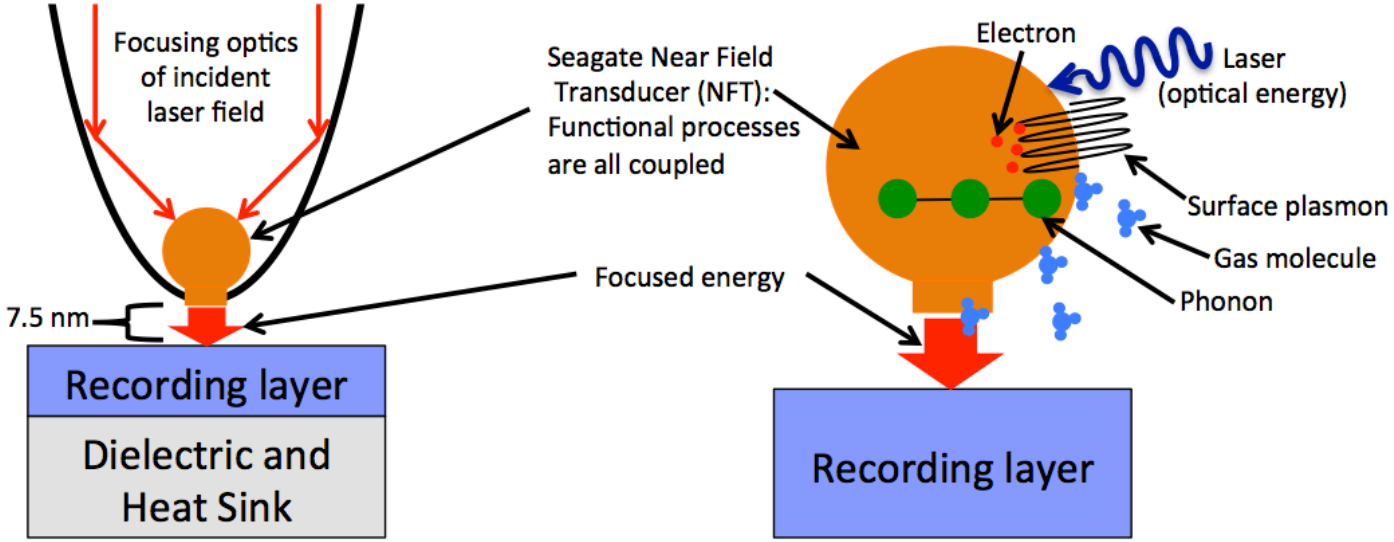
Electron-phonon coupling in metals

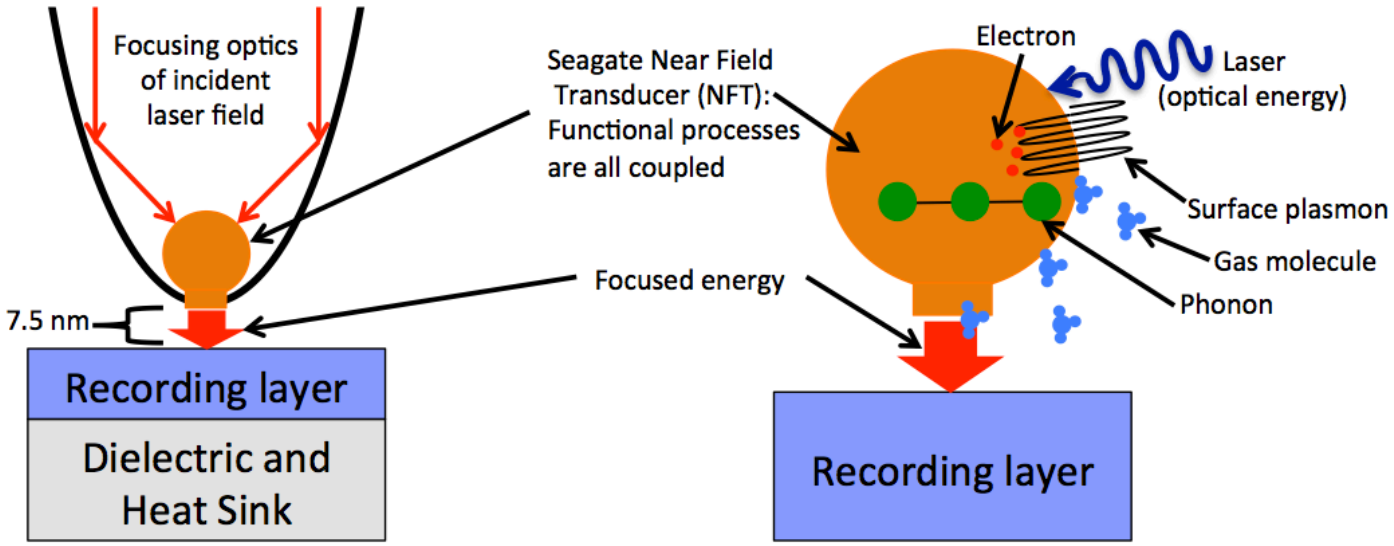


- Areal storage density of hard disk drives
- Recent advancement by Seagate Technology and their HAMR devices (red diamonds)

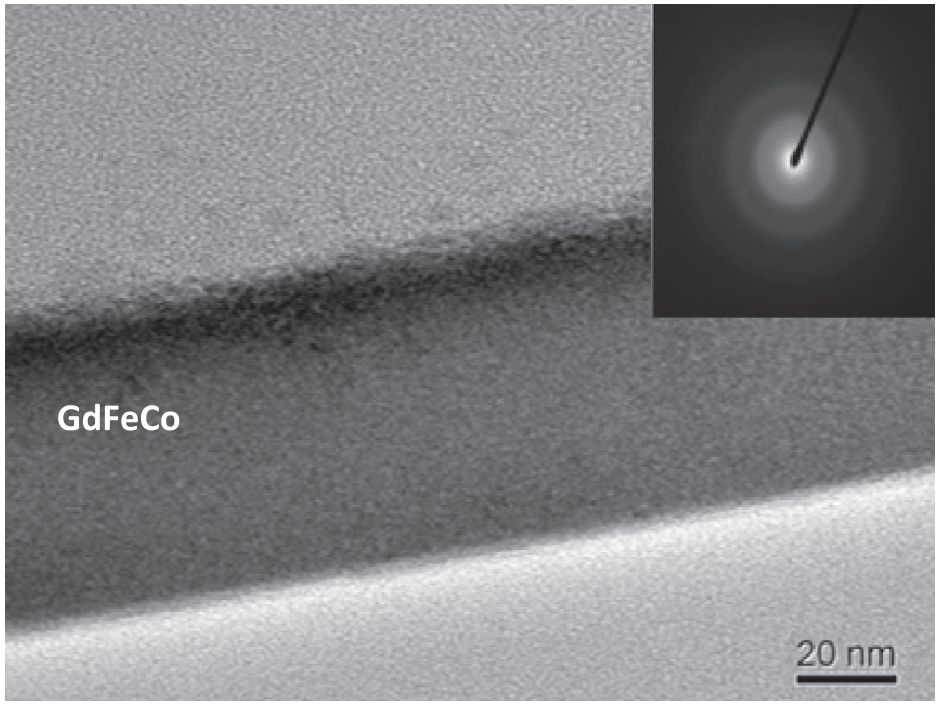


Outline

- Electron-phonon coupling in recording layer
- What is temperature dependence of e-p coupling factor in amorphous metals?



Amorphous GdFeCo and TbFeCo



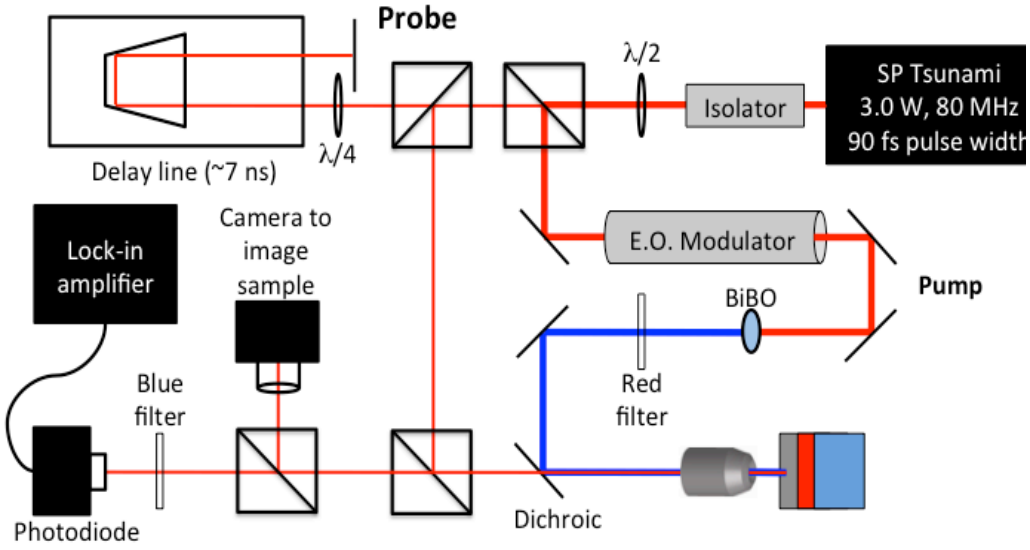
- How does amorphous "lack of structure" affect transport?

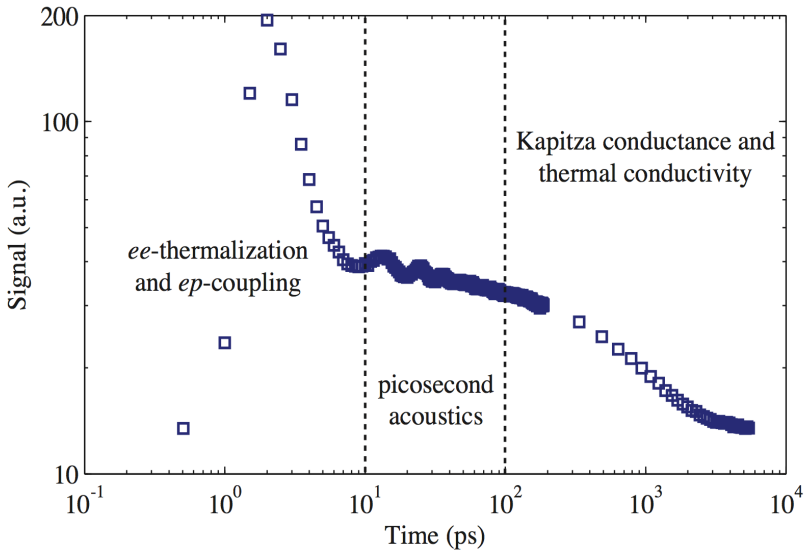
J. Phys. F: Metal Phys., 10(1980)471–6. Printed in Great Britain

The electron–phonon coupling constant of amorphous metals

J Jäckle and K Froböse
Fachbereich Physik, Universität Konstanz, Konstanz, West Germany

Thermal properties in metals: TDTR ideal





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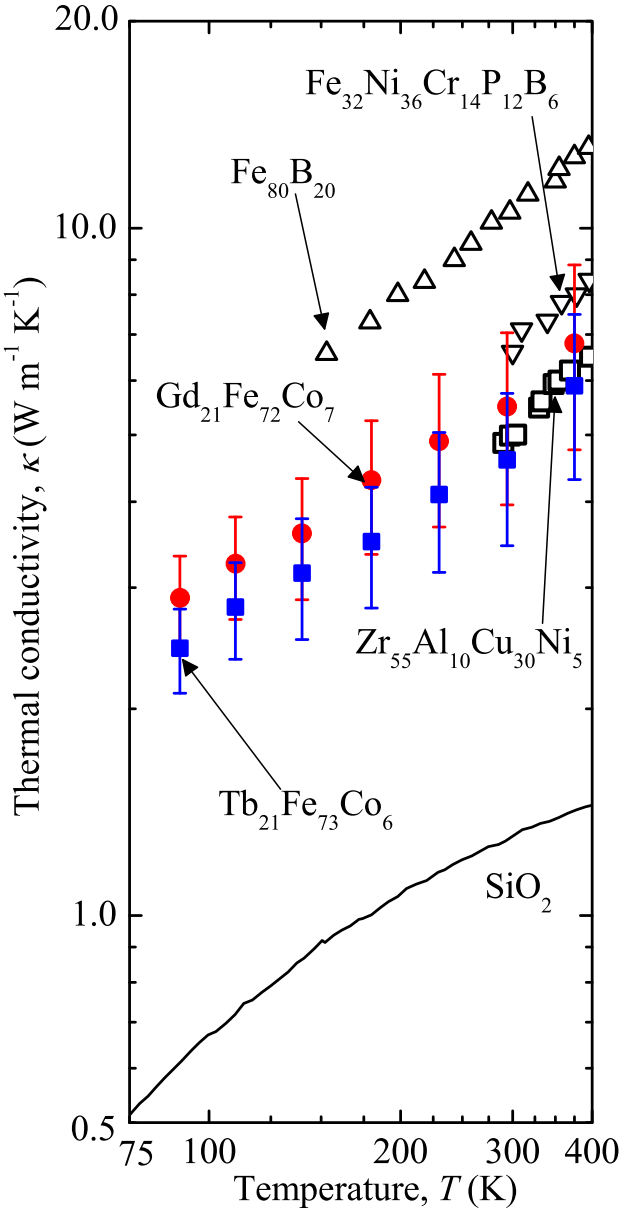
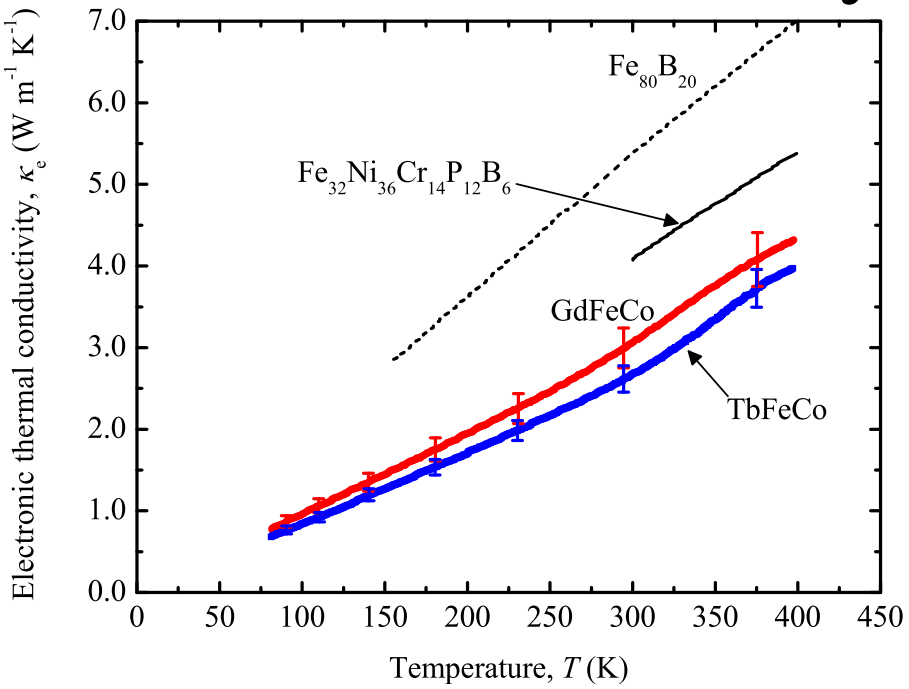
Thermal conductivity of RE-TMs

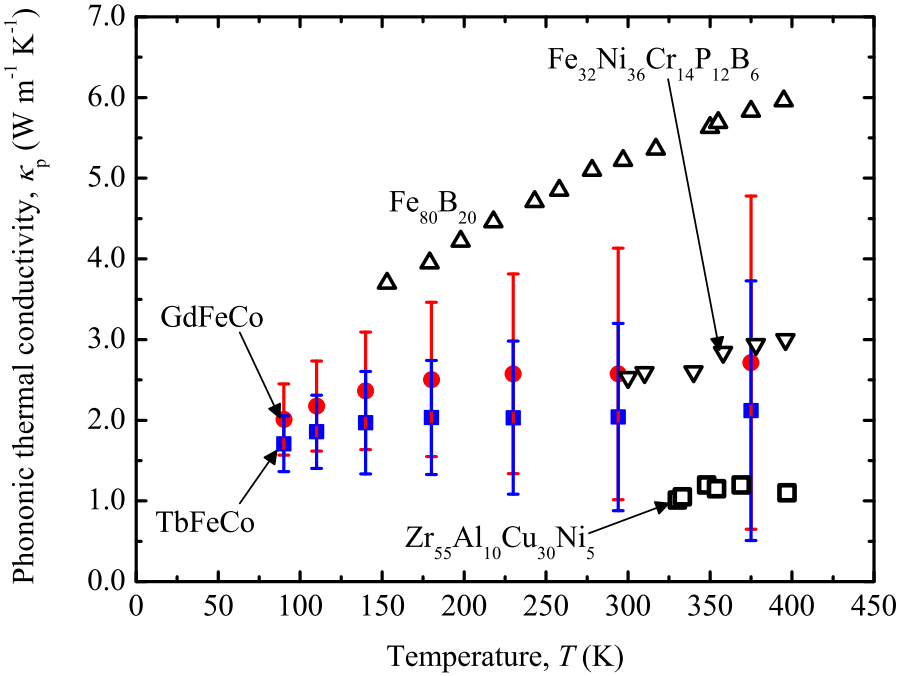


Electron vs. phonon contribution

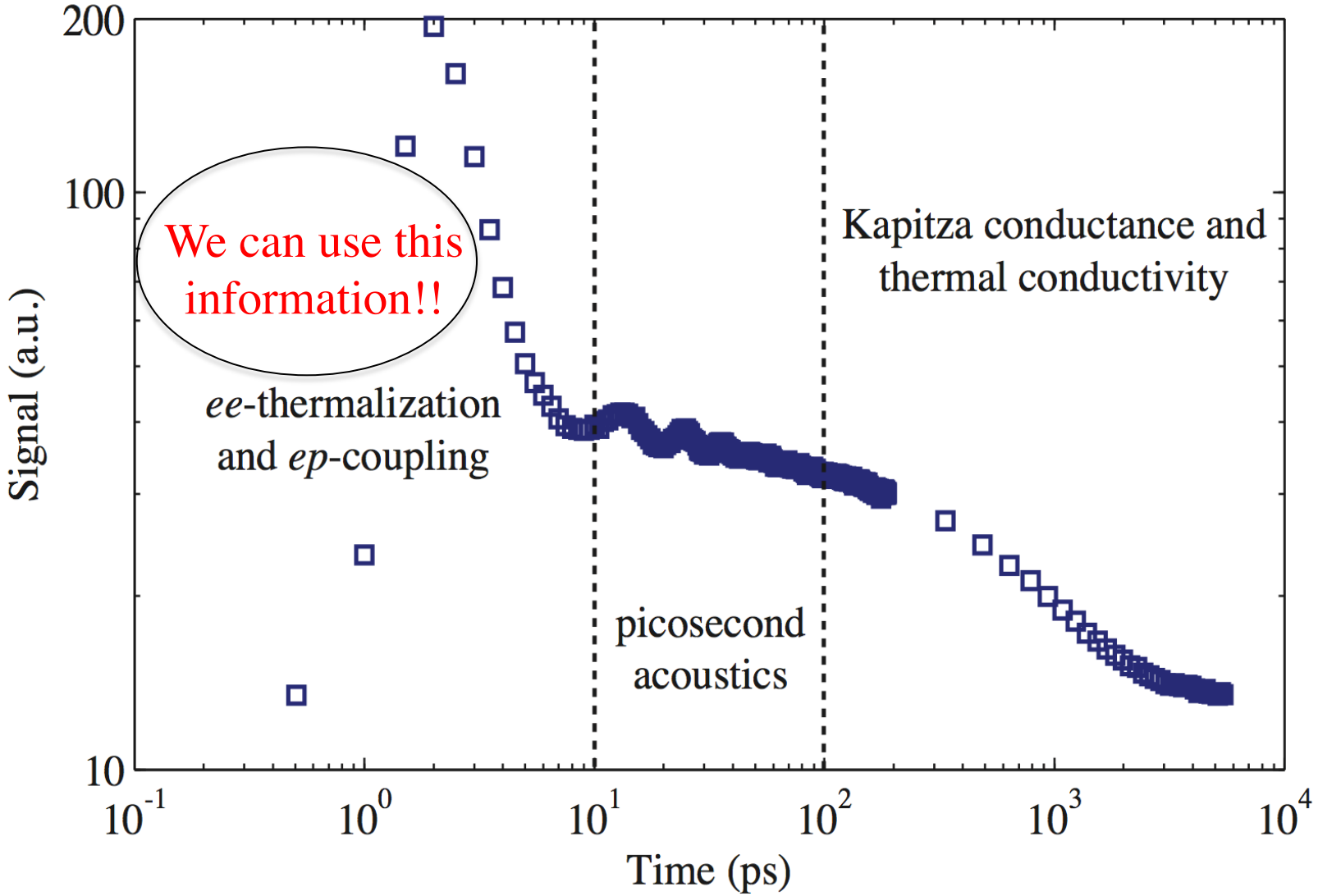
Electrical resistivity



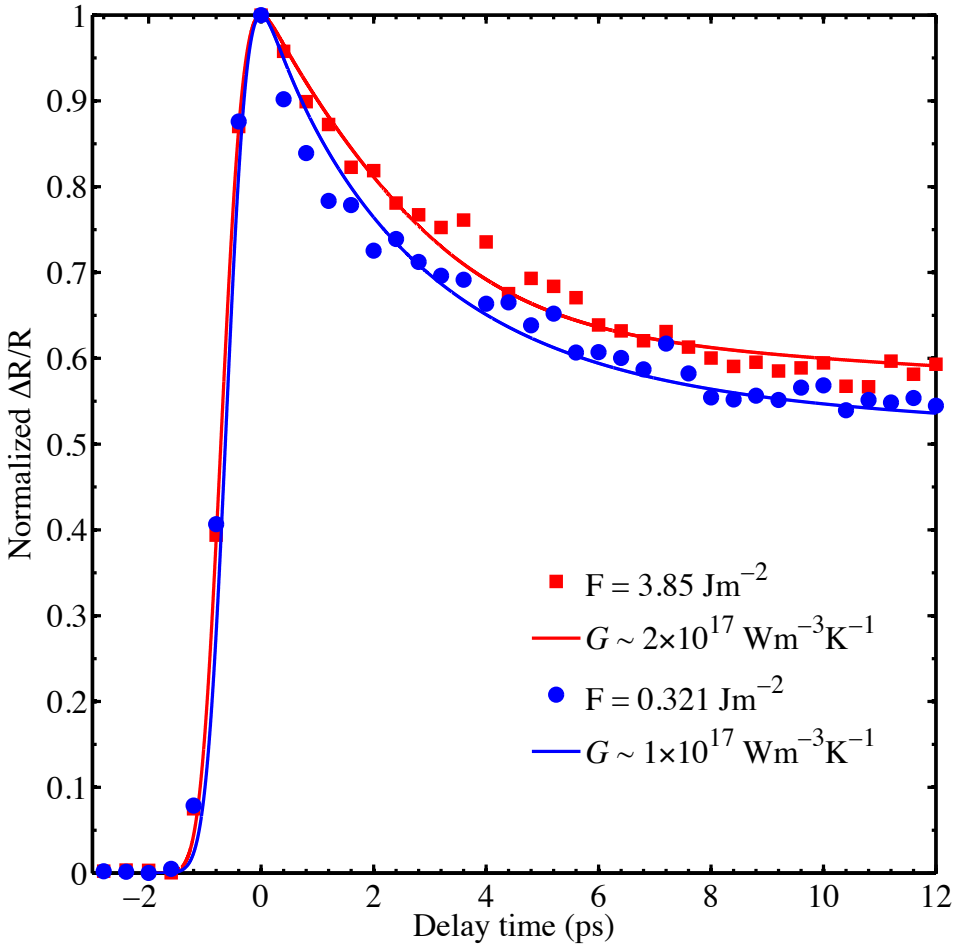
W-F Law



Why is thermal conductivity of a-metals dominated so much by phonons?



EP coupling in GdFeCo and TbFeCo



We can use this method for any metal

Re-examining Electron-Fermi Relaxation in Gold Films With a Nonlinear Thermoreflectance Model

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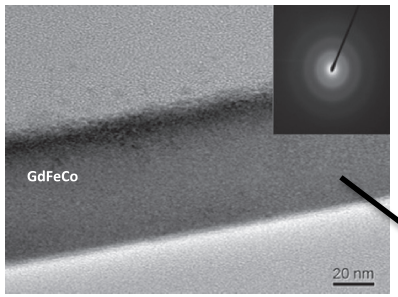
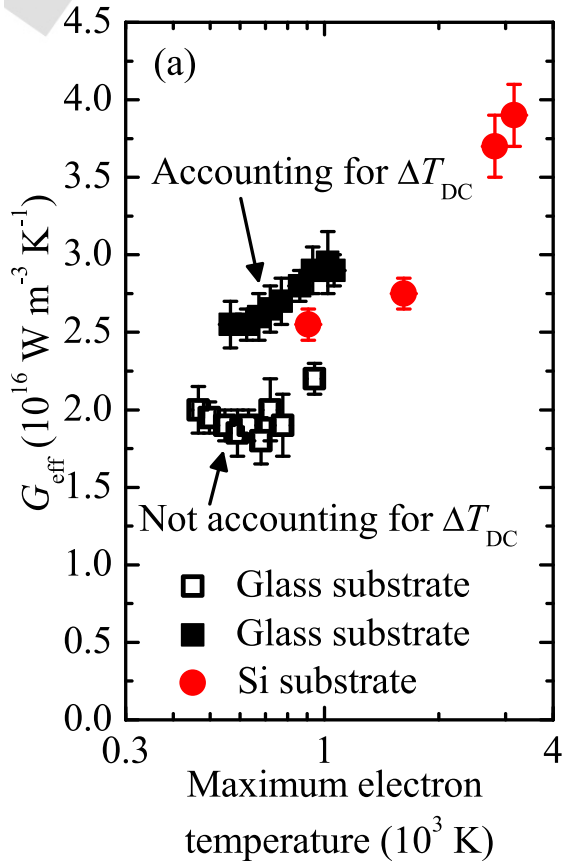
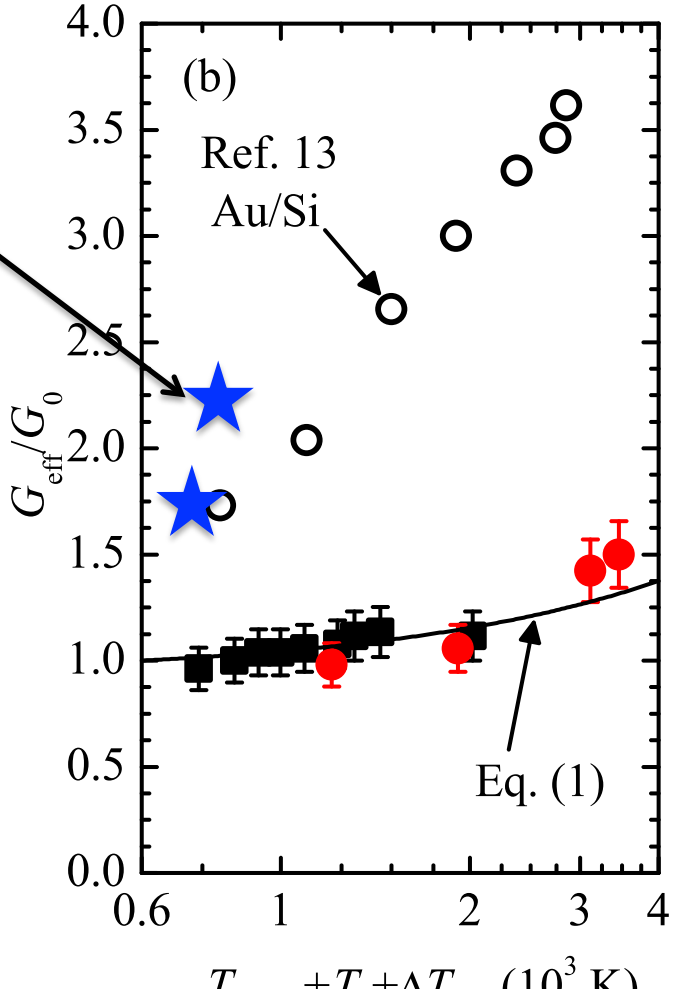
Journal of Heat Transfer

EP coupling in GdFeCo and TbFeCo



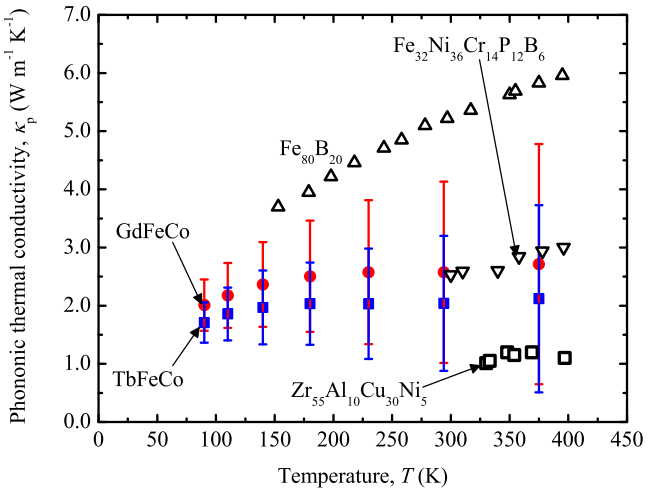


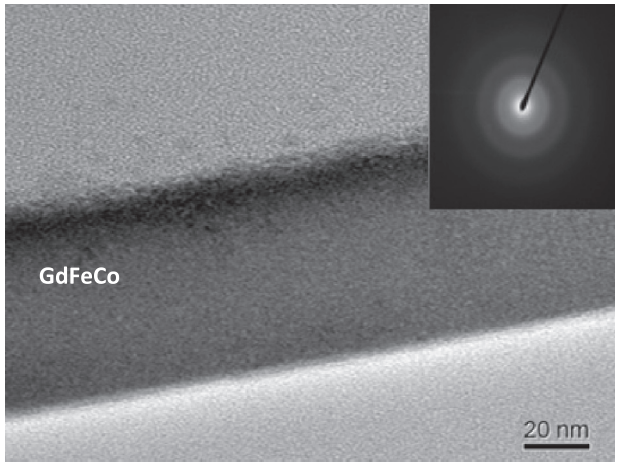


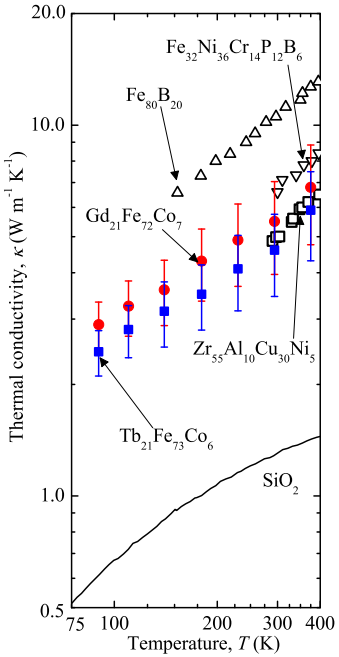
$$G_{\text{eff}} = \frac{\pi^2 m_e v_s^2 n_e}{6}\left(A_{ee}(T_e + T_p) + B_{ep}\right)$$

Challenges – can we engineer the e-p coupling factor?

- Amorphous metals have high electron-phonon coupling factors
- EP scattering is primary resistance, leading to low thermal conductivity
- Structure effects on ep scattering are not as well studied as we think







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Papers on work

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APPLIED PHYSICS LETTERS **103**, 211910 (2013)

Ultrafast and steady-state laser heating effects on electron relaxation and phonon coupling mechanisms in thin gold films

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