

Characterization of Magnetic Thin Films for Actuating Origami Devices

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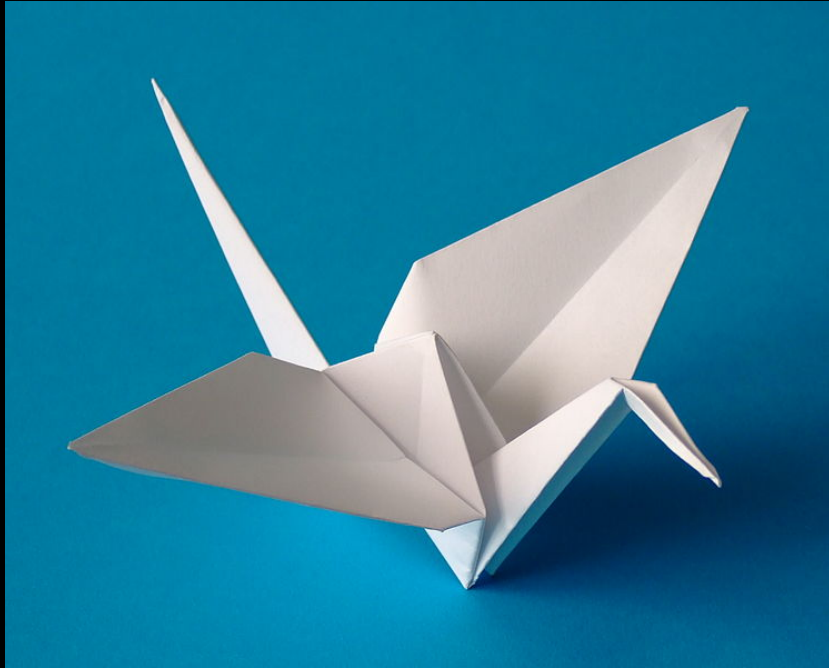


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Motivation



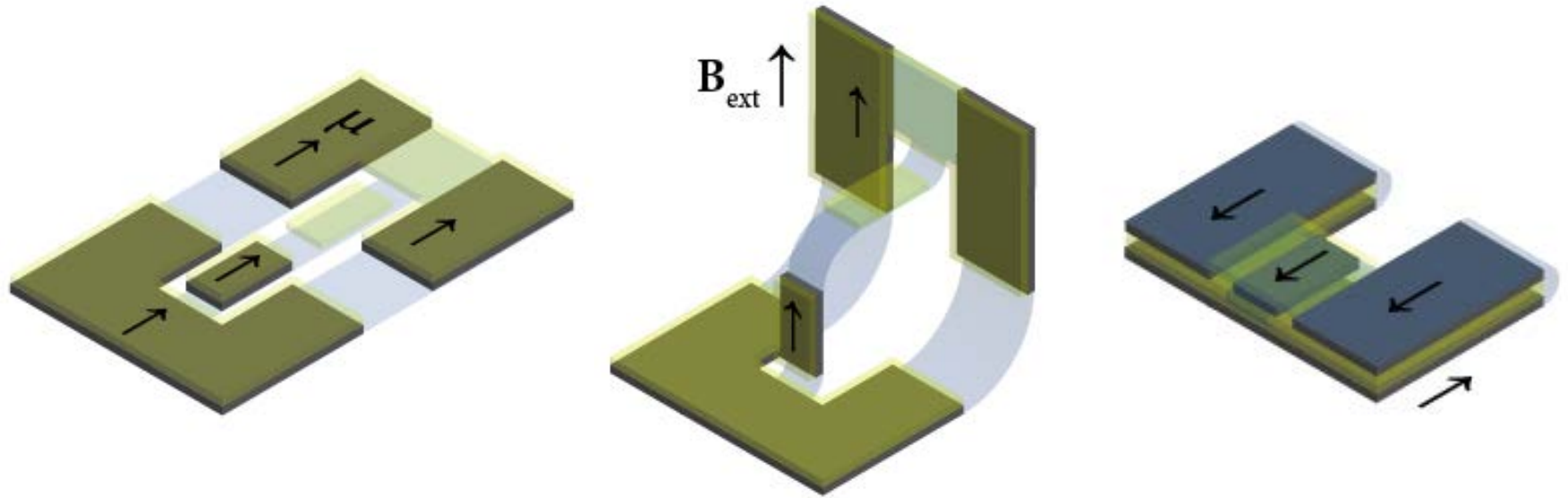
<https://commons.wikimedia.org/wiki/File:Origami-crane.jpg>



<http://news.bbc.co.uk/2/hi/science/nature/3920685.stm>

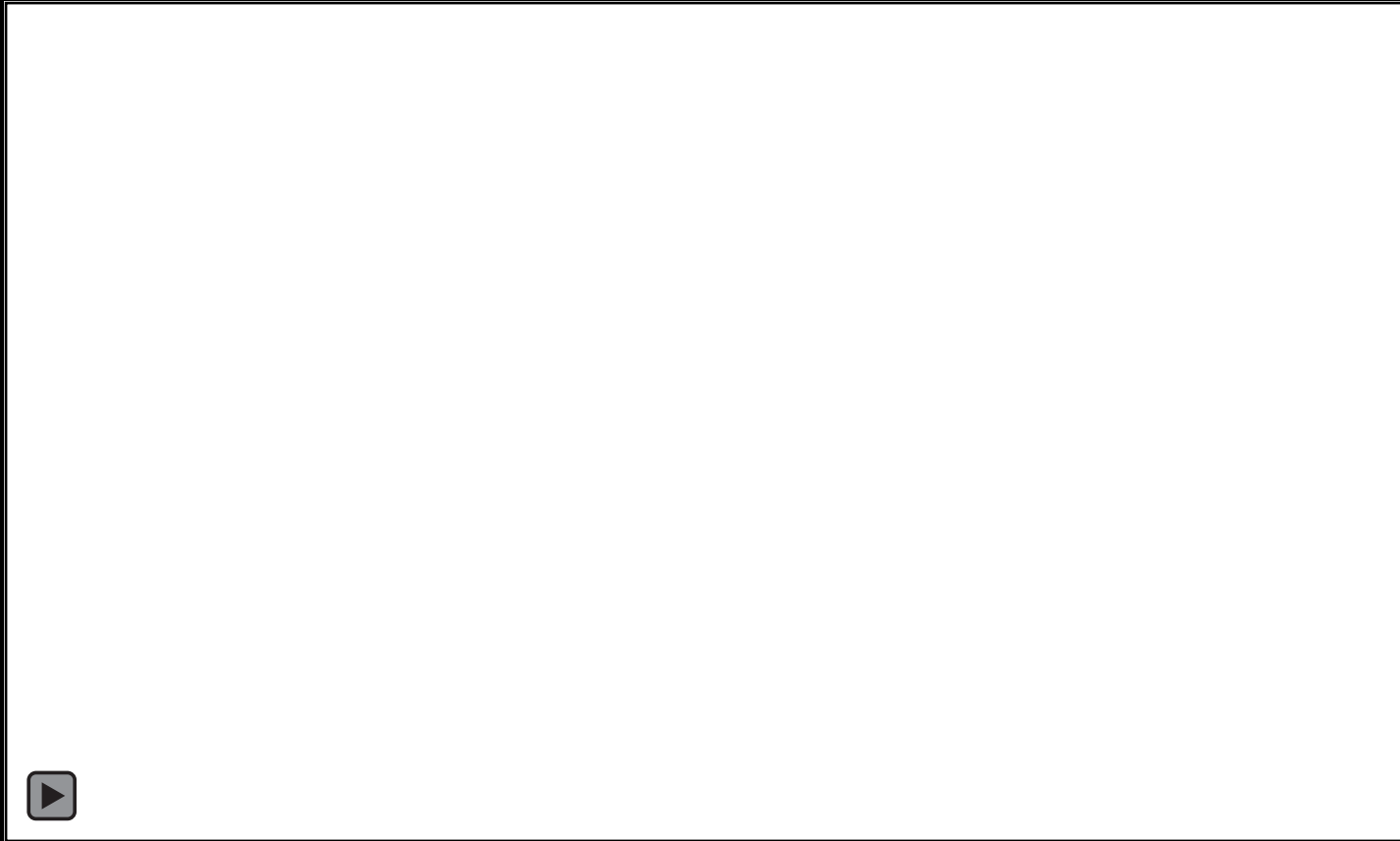


Background



Background

Use magnetic films in fabrication



Experiment

- **Deposit cobalt, nickel, and iron**
- **Deposit at 25 nm and 50 nm**



http://www.cnf.cornell.edu/cnf5_tool.taf



Experiment



http://www.cnf.cornell.edu/cnf5_tool.taf

- **Verify thickness**

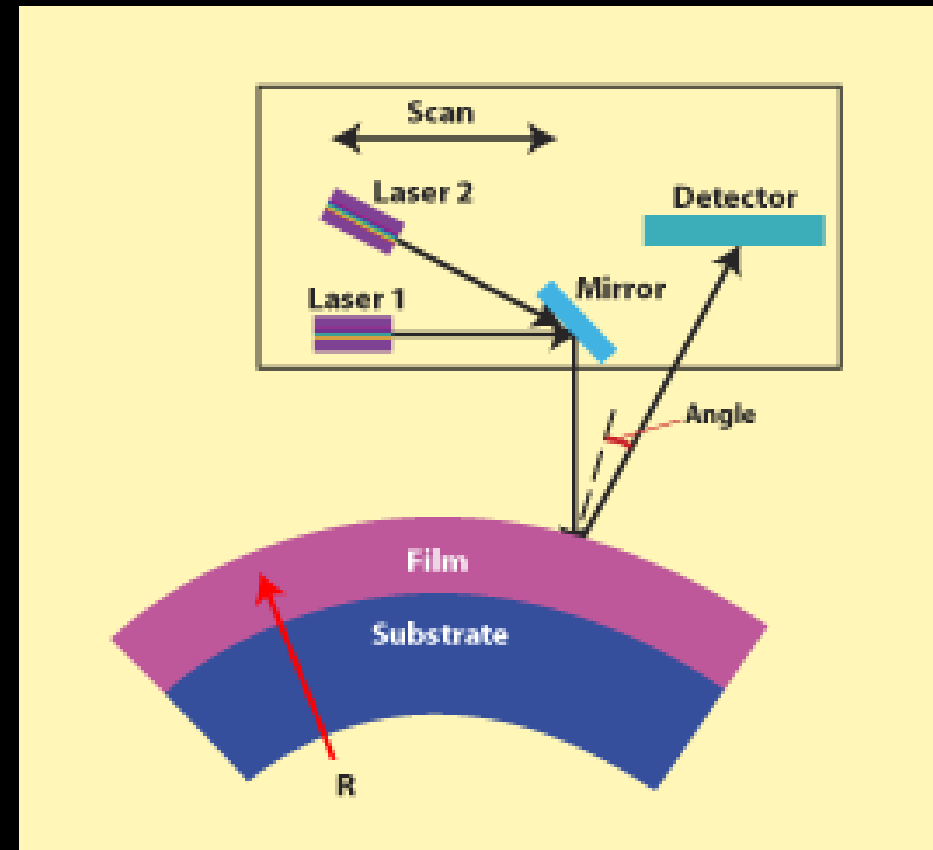


Experiment: Stress

- Conduct stress measurements

Stoney's Equation:

$$\sigma = \frac{E_s t_s^2}{6(1 - \nu_s) t_f} \left(\frac{1}{R_{post}} - \frac{1}{R_{pre}} \right)$$



<http://www.tohotechnology.com/flx-series.php#Theory>



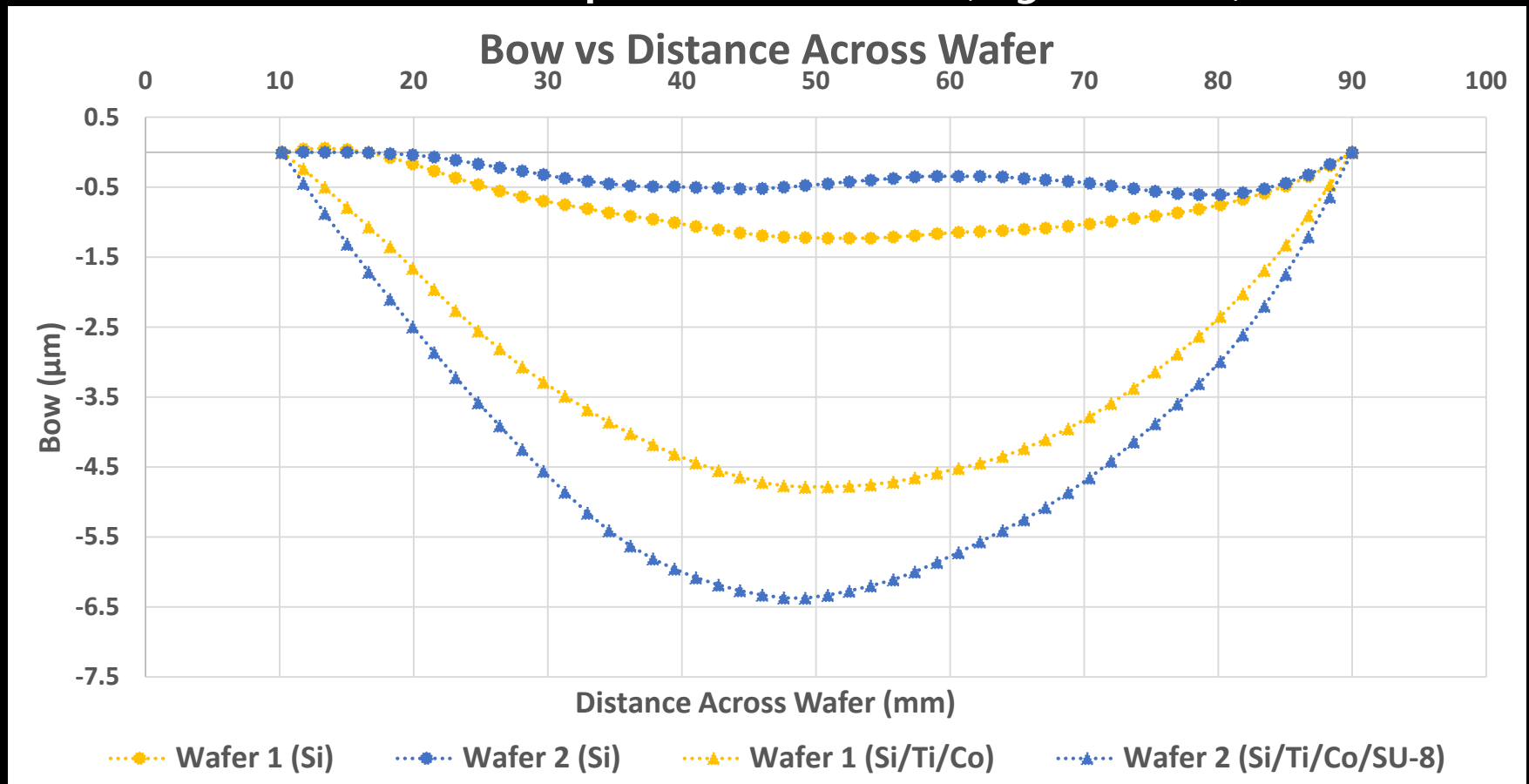
Results: Stress

- Average stress measured in films:
 - Fe ~ 820 MPa
 - Co ~ 400 MPa
 - Ni ~ 170 MPa



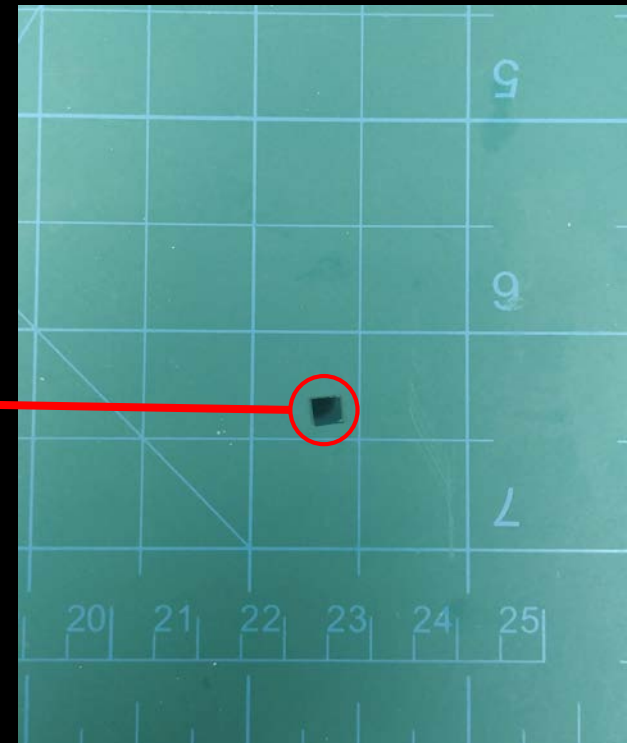
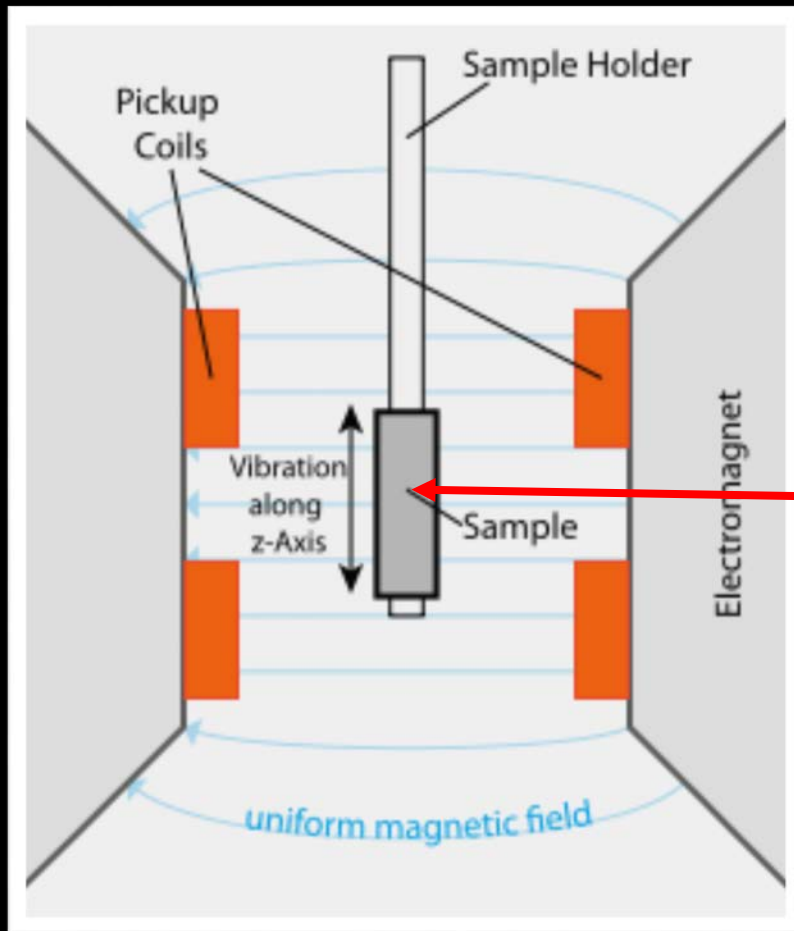
Results: Stress

- Addition of SU-8 photoresist reduced stress in composite film (by 90%)



Experiment: Vibrating-Sample Magnetometer (VSM)

- Characterize magnetic properties



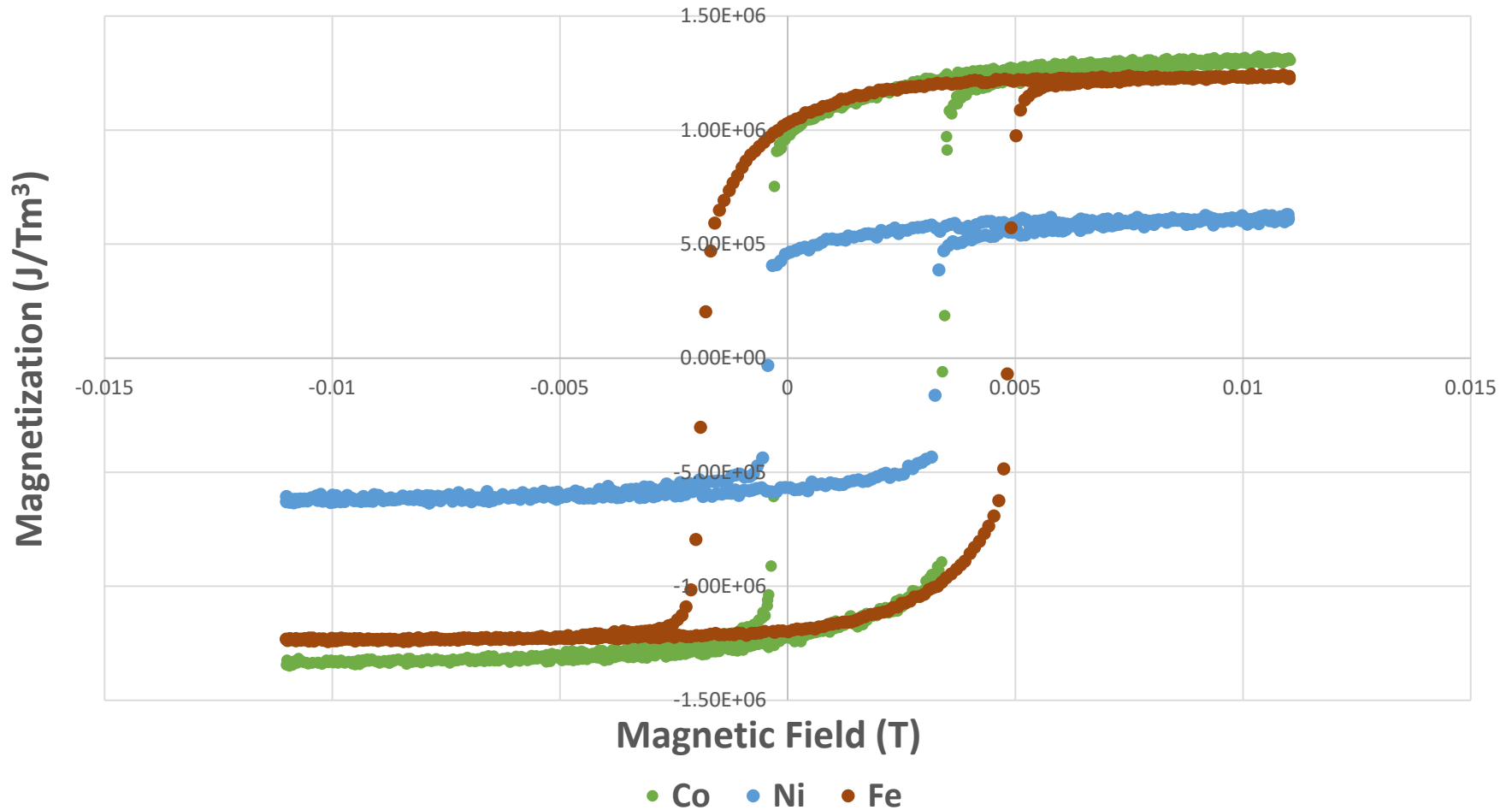
https://en.wikipedia.org/wiki/Vibrating-sample_magnetometer#/media/File:VSM_en.svg



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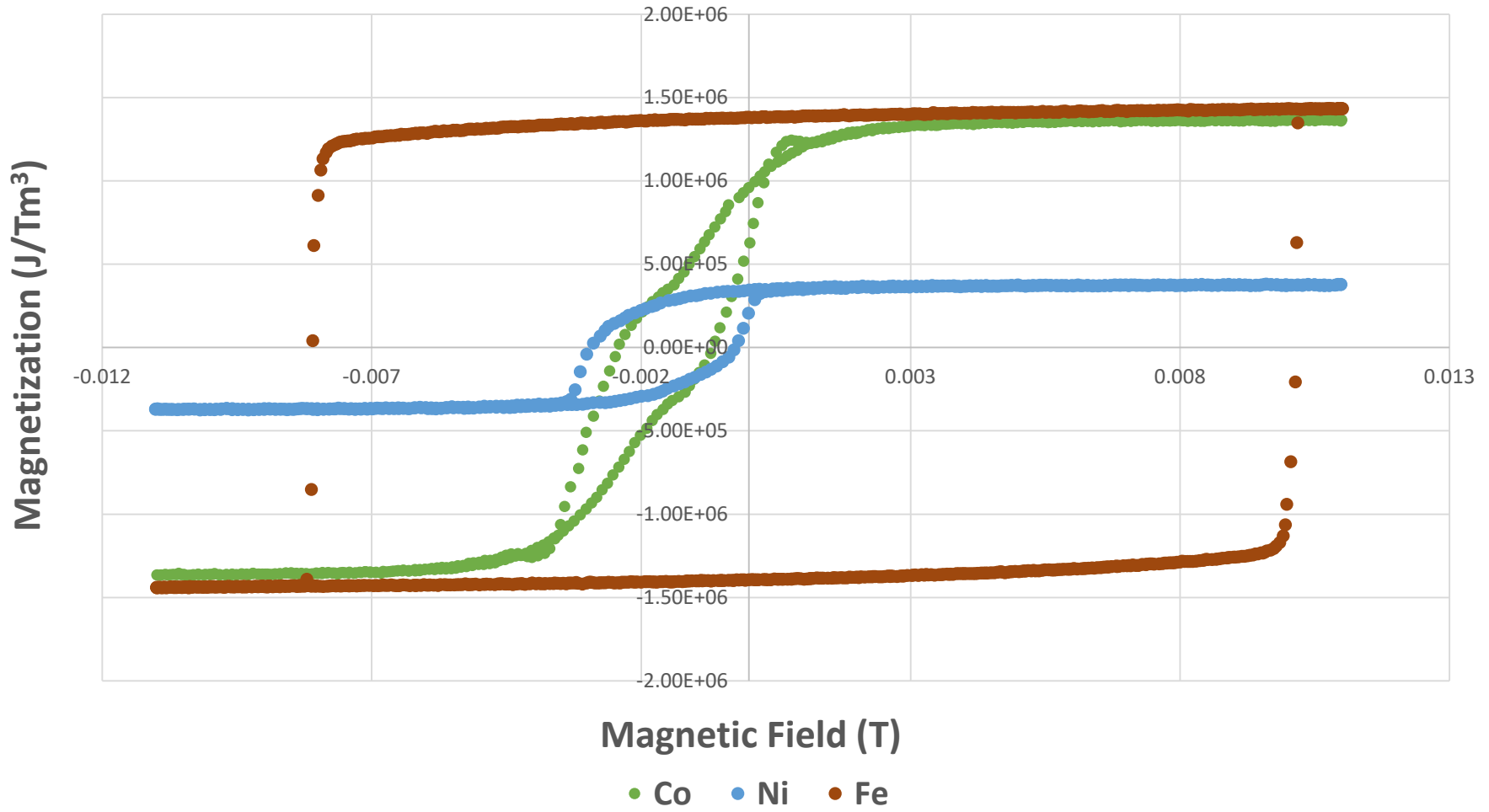
Results: VSM

25 nm - Magnetization vs Magnetic Field



Results: VSM

50 nm - Magnetization vs Magnetic Field



Conclusions & Acknowledgements

- **Conclusions:**
 - Co and Fe have higher magnetization
 - Ni has lower stress

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 - National Science Foundation
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