Marshall University
Department of Physics
Optics Lab

Thermally-Induced Structural Change Measured by Holographic Non-destructive Testing

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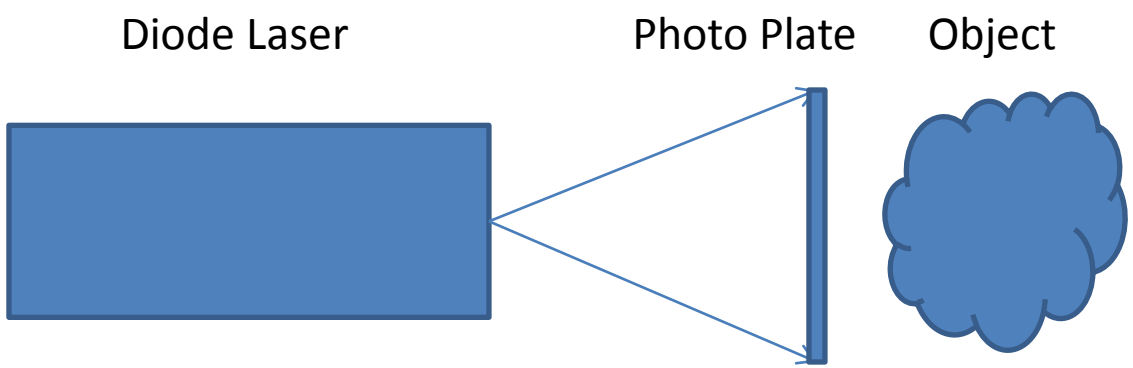
Holography

- Transmission Hologram

  - Typically two beams, need laser, beam splitter, spatial filters, etc.

- Reflection Hologram – simple, inexpensive

  - T. H. Jeong simple geometry, all materials from www.integraf.com



HNDT

- Simple Holography – students enjoy visual results
- HNDT stretches project beyond pretty pictures.
- HNDT – four basic types
    1. time-averaged
    2. real-time
    3. sandwich
    4. double exposure

Double Exposure HNDT

- Process:
    1. Initial exposure of object.
    2. Apply stress to object.
    3. Second exposure of object.
    4. Process film.

Stress for HNDT

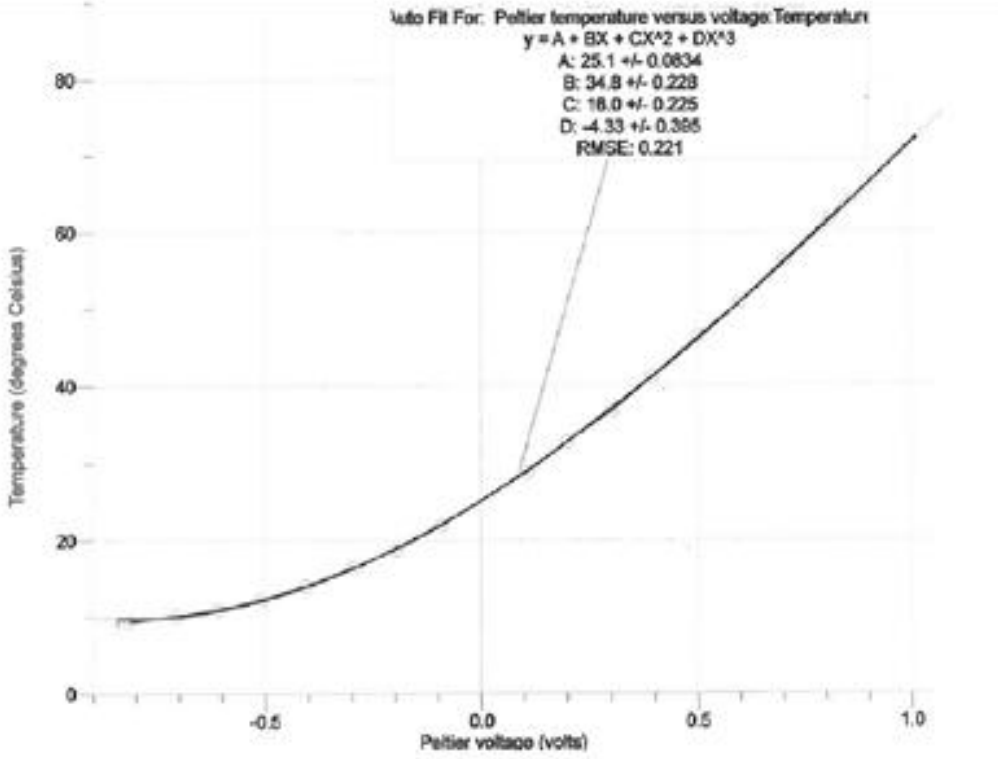
- Possible stress sources:
    1. mechanical – string over pulley with mass.
    2. change internal pressure on closed object.
    3. magnetic deflection of object.
    4. thermal change in object.
    5. other…….

Thermal change achieved with ***Peltier device***.

Pluses: compact, voltage activated, rugged, allows student choices in experiment design.

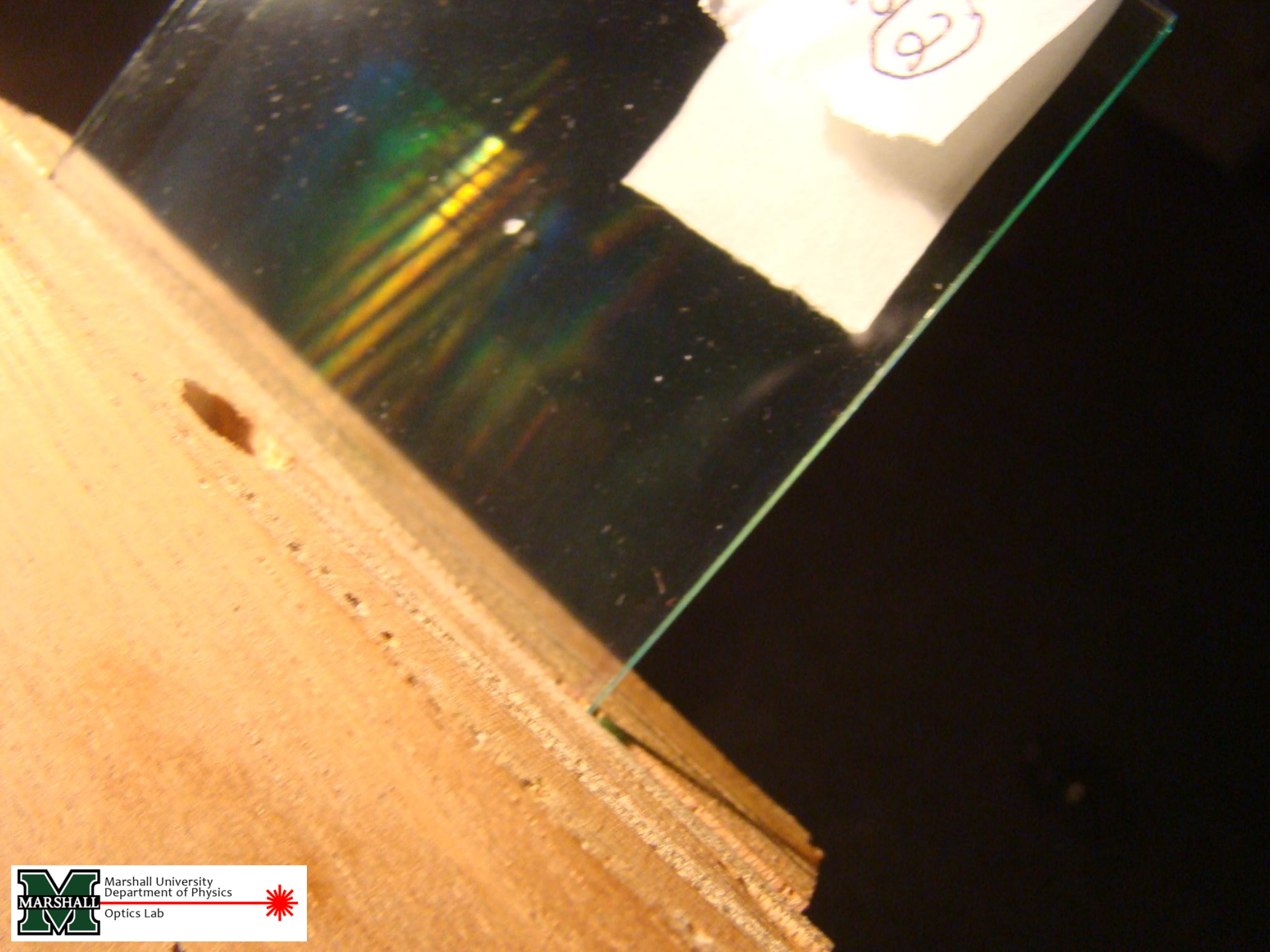
Peltier Device

	Peltier temperature versus voltage	
	Peltier voltage (volts)	Temperature (degrees Celsius)
1	-0.815	9.4
2	-0.708	10.2
3	-0.608	11.0
4	-0.508	12.3
5	-0.404	14.1
6	-0.296	16.5
7	-0.196	18.8
8	-0.092	21.9
9	0.107	28.9
10	0.199	32.7
11	0.304	36.7
12	0.394	41.1
13	0.502	46.4
14	0.595	50.6
15	0.702	56.2
16	0.807	61.6
17	0.904	66.4
18	0.996	71.2



HNDT Setup

Reflection hologram apparatus: laser on left, film plate on wooden block clamp, and object (padlock) on Peltier device.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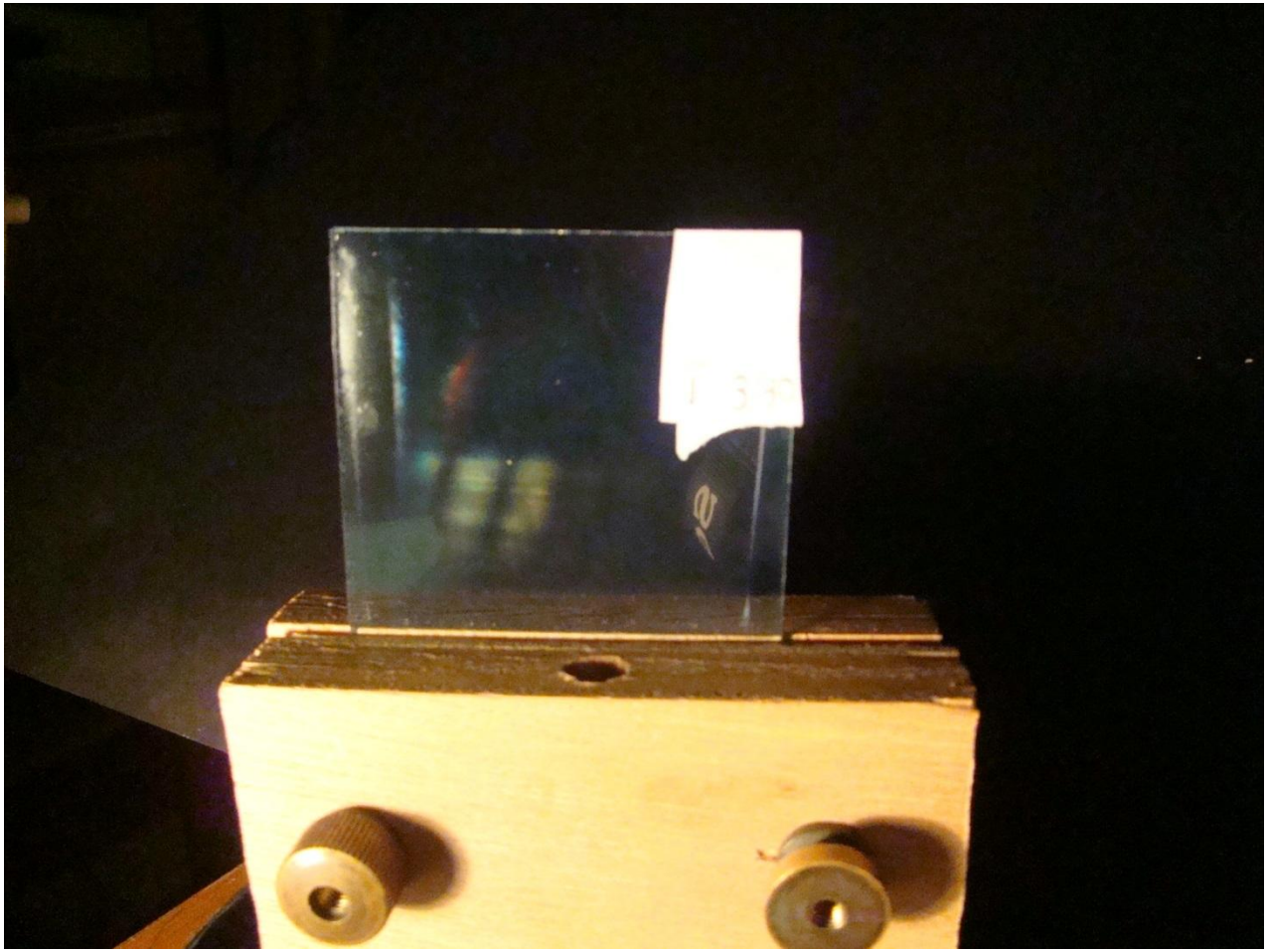
Objects with Fringes



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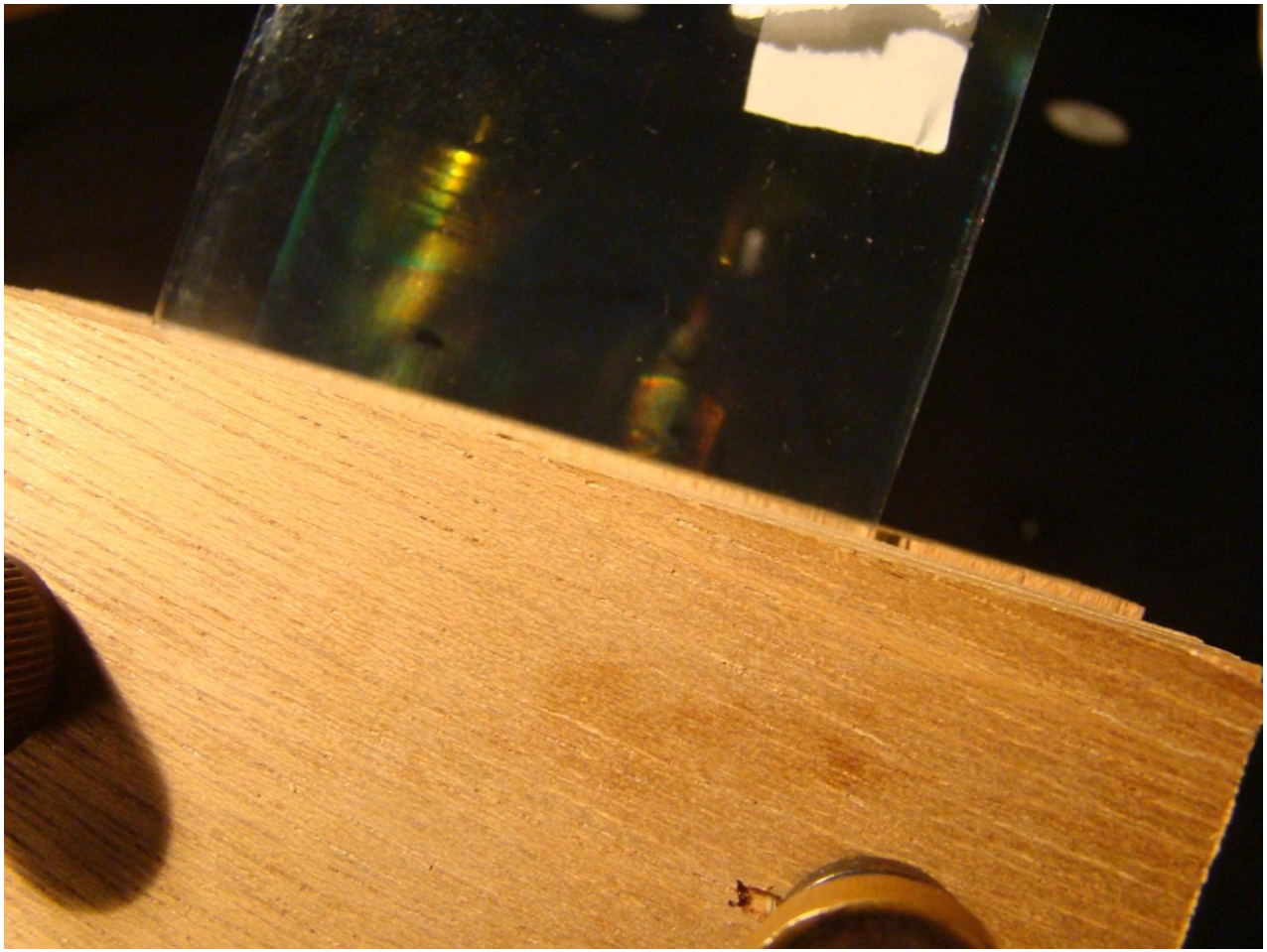

Conclusion

- Peltier effect heating a useful pedagogical tool to use with reflection holography
- Peltier process is open ended:
  - -change Peltier voltage
  - -change time interval between images
  - -process is very inexpensive

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