Measuring Refractive Indices of Nematic LC Elastomers

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Outline

- Motivation
- Nematic LC elastomer
- Methods and previous results
- Theory
- Materials selection
- Experimental setup
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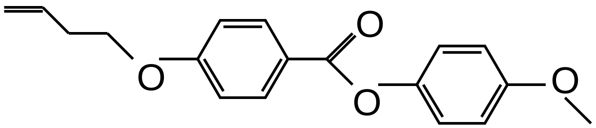
- Conclusions
- Acknowledgments

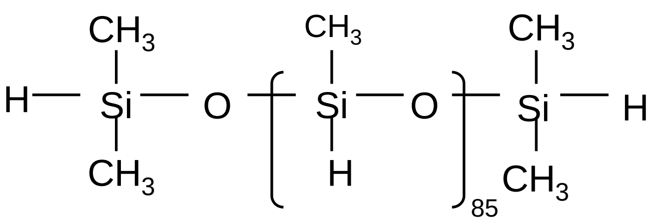
Motivation

- Nematic LC Elastomers have bright future
- Not all physical properties are quite extensively described so far
- E.g. Refractive index

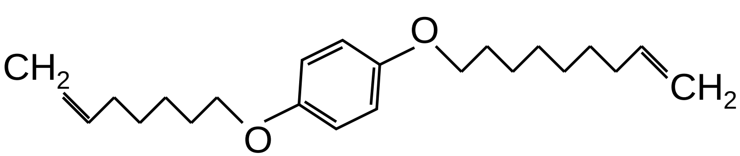
Nematic LC elastomer



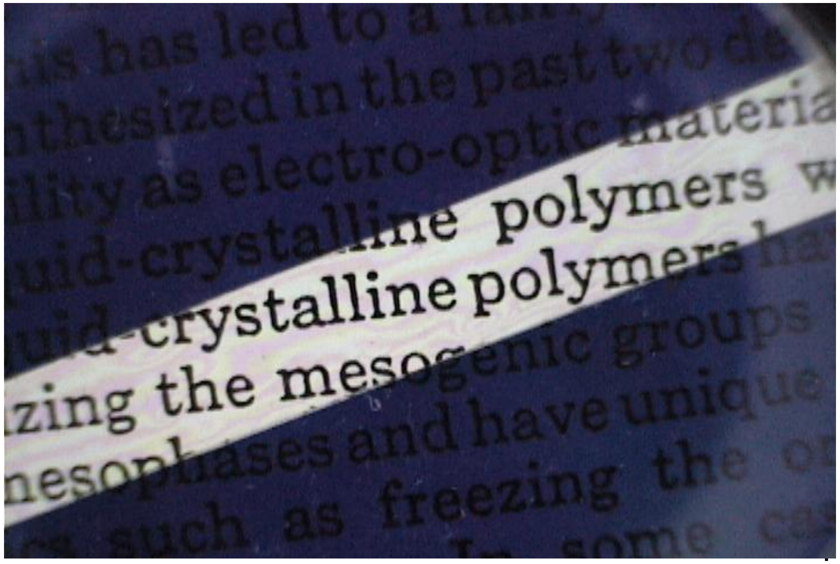
Mesogen



Backbone

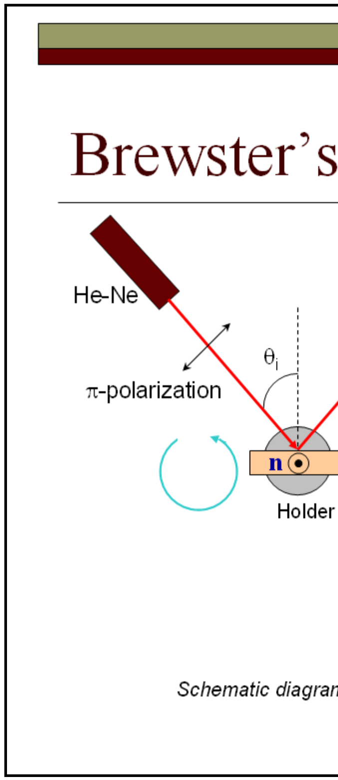


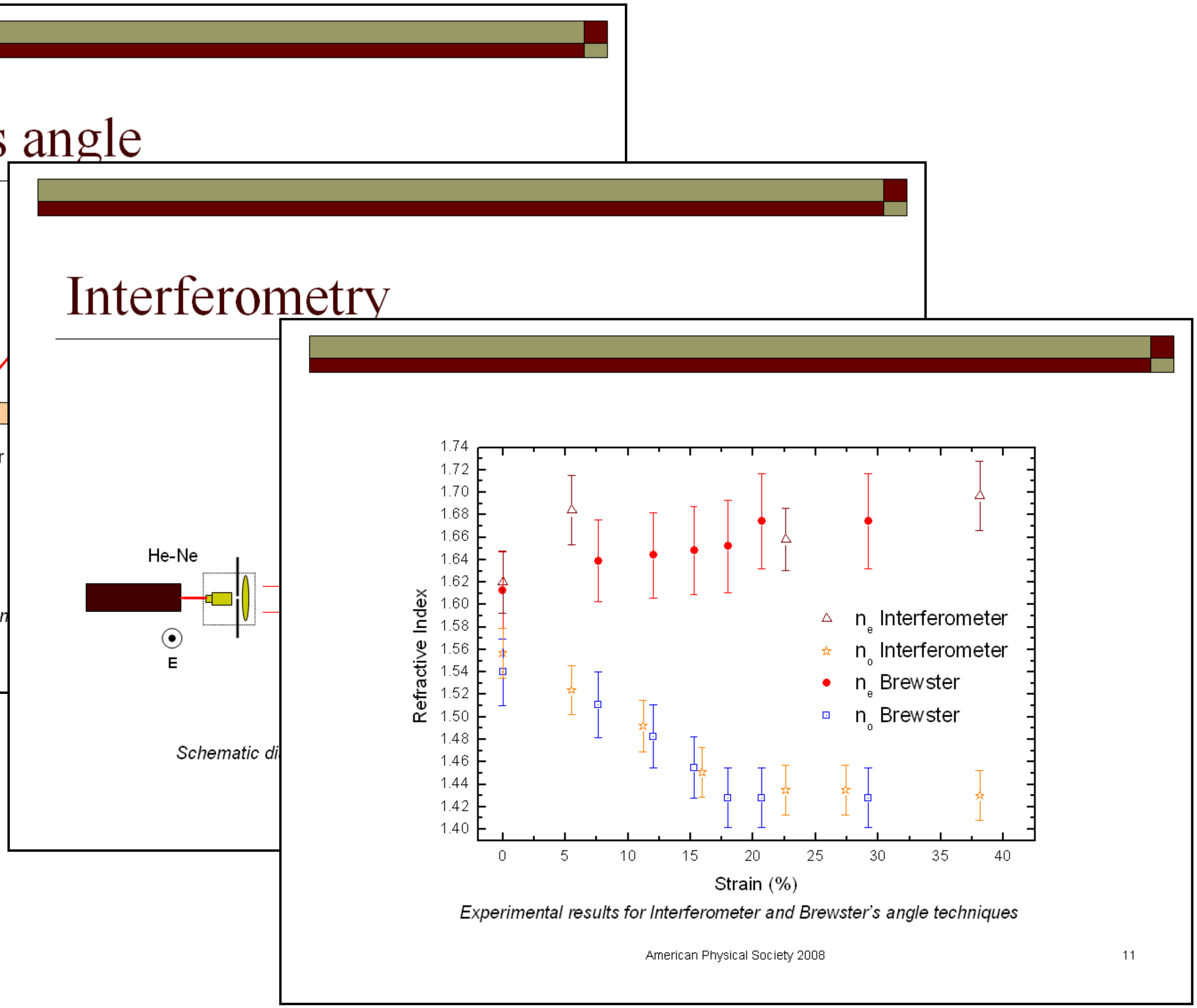
Crosslinker



From Israel Lazo presentation

Methods





Israel Lazo presentation

Yet another approach

- From Fresnel equations:

$$R = \left(\frac{n_1 - n_2}{n_1 + n_2}\right)^2$$

$$T = 1 - R = \frac{4 n_1 n_2}{\left(n_1 + n_2\right)^2}$$

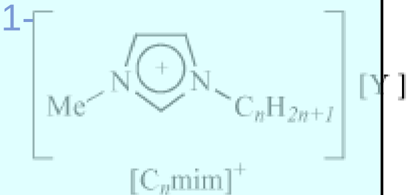
The main idea of the method
R=0

High refractive index liquids

- Liquids at or near 20˚C

Refractive index	Material
1.627	Quinoline
1.660	α-M
1.717	Me
1.737	Me
1.78	Me
1.793	Bar
1.82	Pot
1.868	Sol ... % S
1.885	Hydrogen disulphide
1.95	Phosphorus in carbon disulphide
2.06	Yellow phosphorus 8 parts by weigh ... thylene iodide
2.2	Mercuric iodide in aniline or quinoline

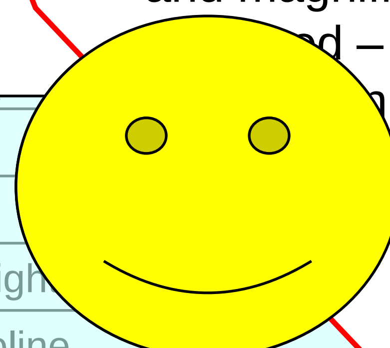
Ionic liquids based on 1-alkyl-3-methylimidazolium cations



Most of them were either:

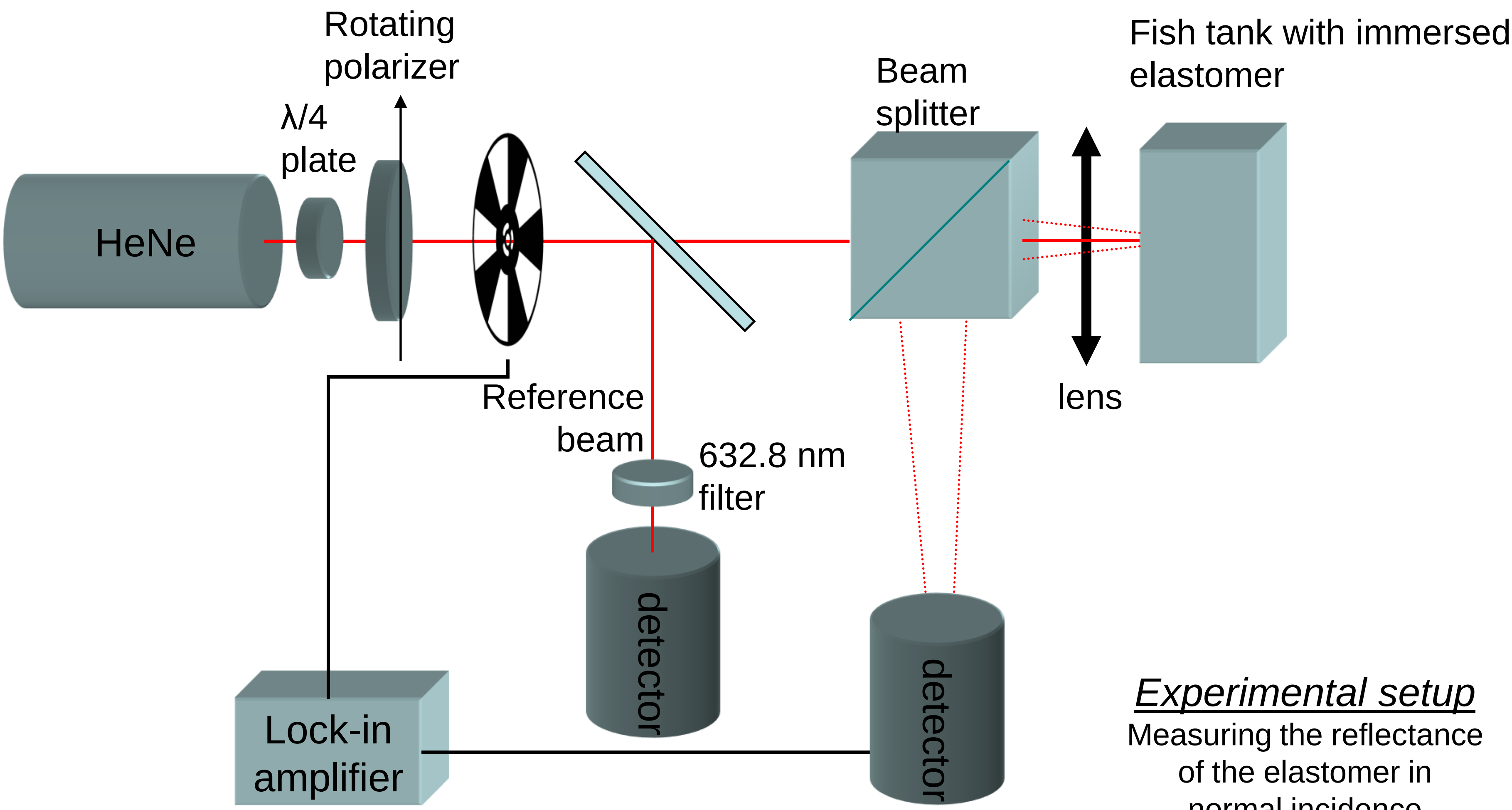
- Highly toxic and poison
- Not transparent
- Not available

A simple, cost-effective and magnificent liquid ...ed – saturated ...n of NaI ...496



Data from Kaye and Laby, Tables of Physical and Chemical Constants, 1959

Experiment

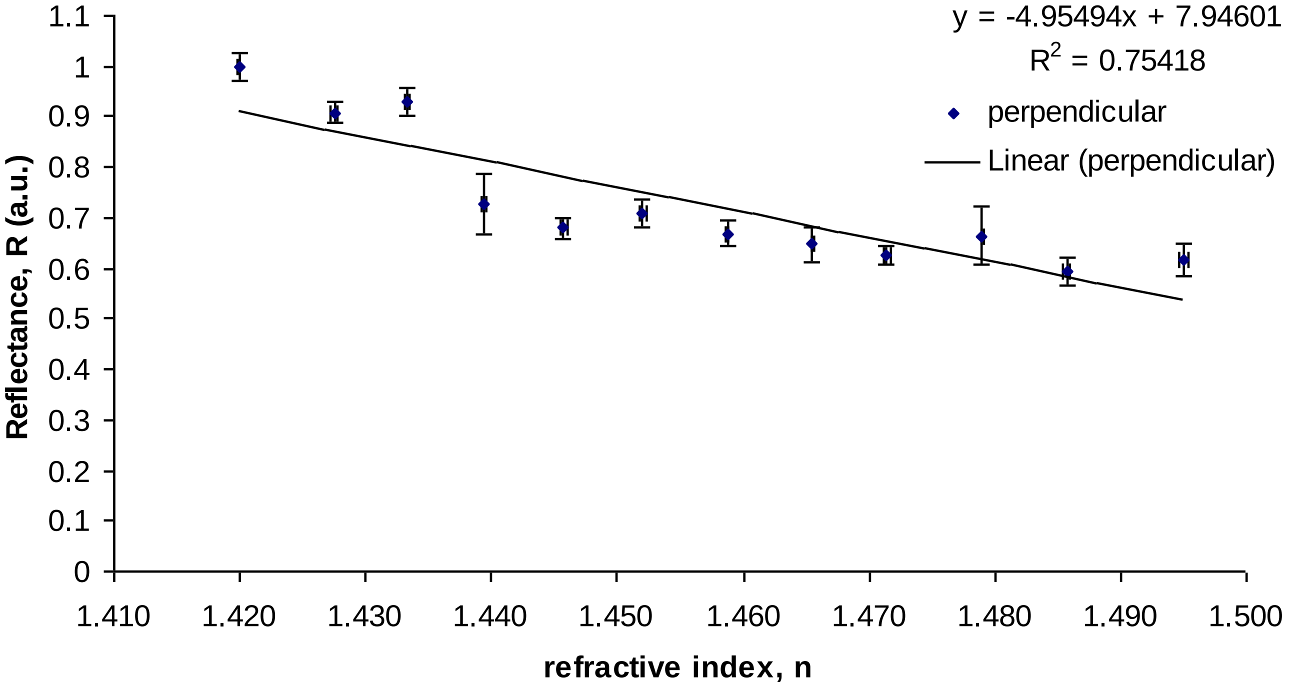


Experimental setup

Measuring the reflectance of the elastomer in normal incidence

n_o measurement

- The polarization is perpendicular to the preferred director orientation **n**



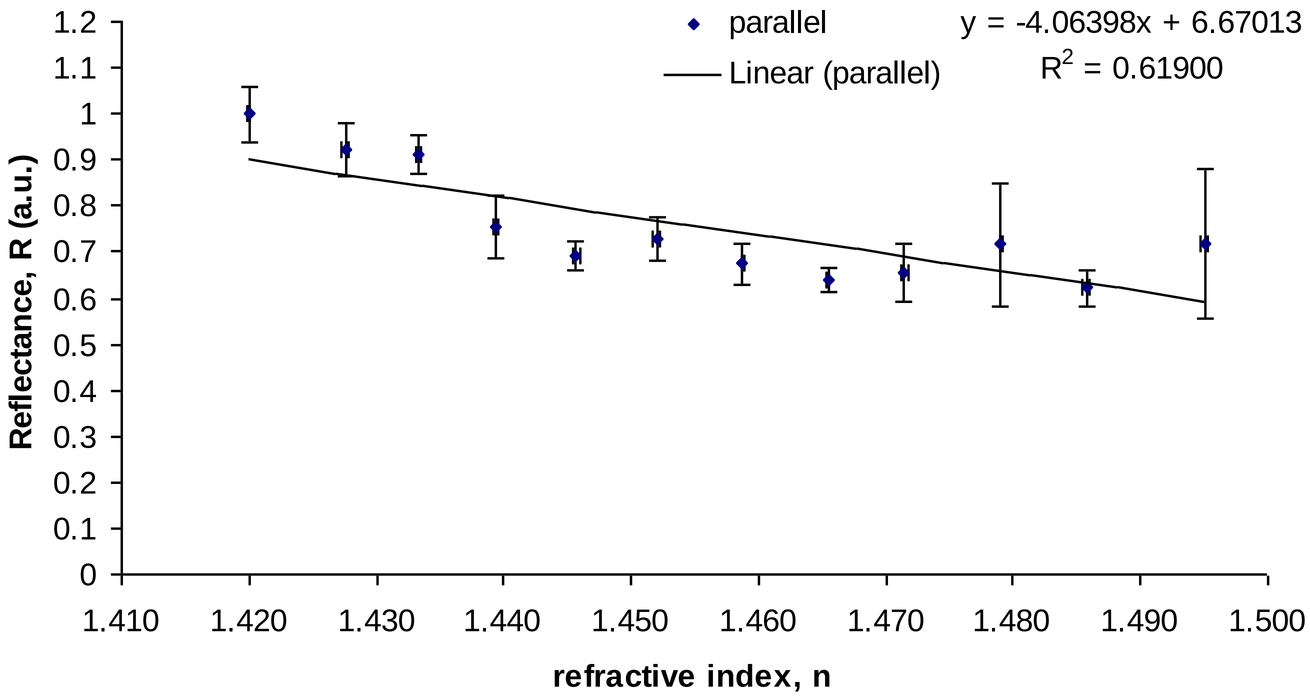
Fitting and extrapolation gives n=1.60365 0.01633

The sample from batch #69 gave similar value n=1.53529

elastomer with no strain
batch #71 (10% cross linkers)

n_e measurement

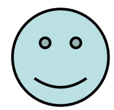
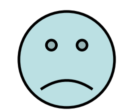
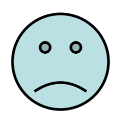
- The polarization is parallel to the preferred director orientation **n**

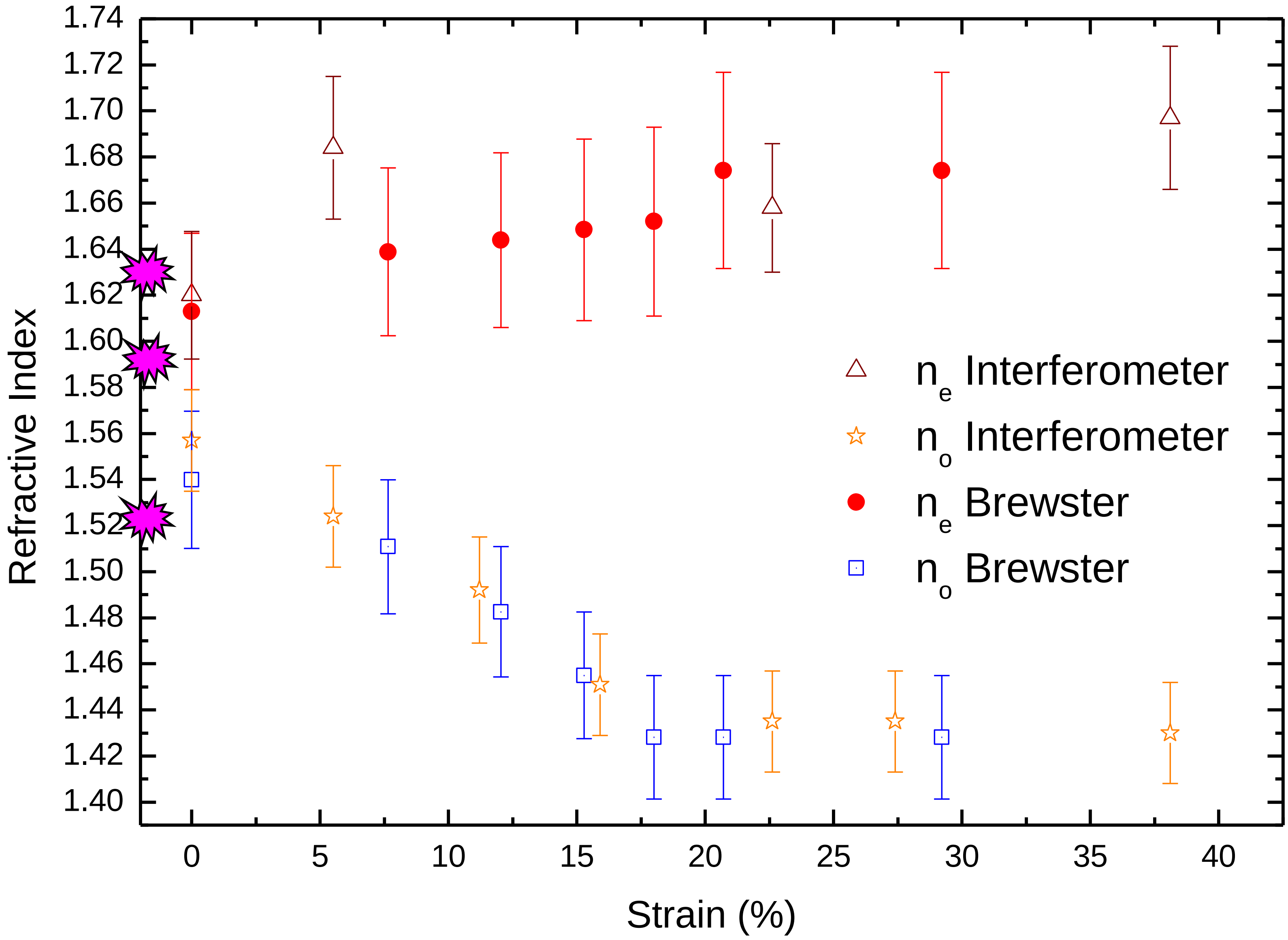


Fitting and extrapolation gives n =1.64128 ±0.03830

elastomer with no strain
batch #71 (10% cross linkers)

Benefits and drawbacks of the method

- Looks simple 
- Inhomogeneity of elastomer 
- Scattering 



Refractive Index
1.74
1.72
1.70
1.68
1.66
1.64
1.62
1.60
1.58
1.56
1.54
1.52
1.50
1.48
1.46
1.44
1.42
1.40
0
5
10
15
20
25
30
35
40
Strain (%)
n_e Interferometer
n_o Interferometer
n_e Brewster
n_o Brewster

Conclusions

- The sample was different but the results agree with previous measurements
- The refractive indices need to be measured more accurately
- Future work: Generalized Ellipsometry
- Need to measure inhomogeneity

Acknowledgement

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Thank you !