

**CBPF**

Centro Brasileiro de  
Pesquisas Físicas

# Estudo por Espectroscopia Raman em filmes finos de ZnO

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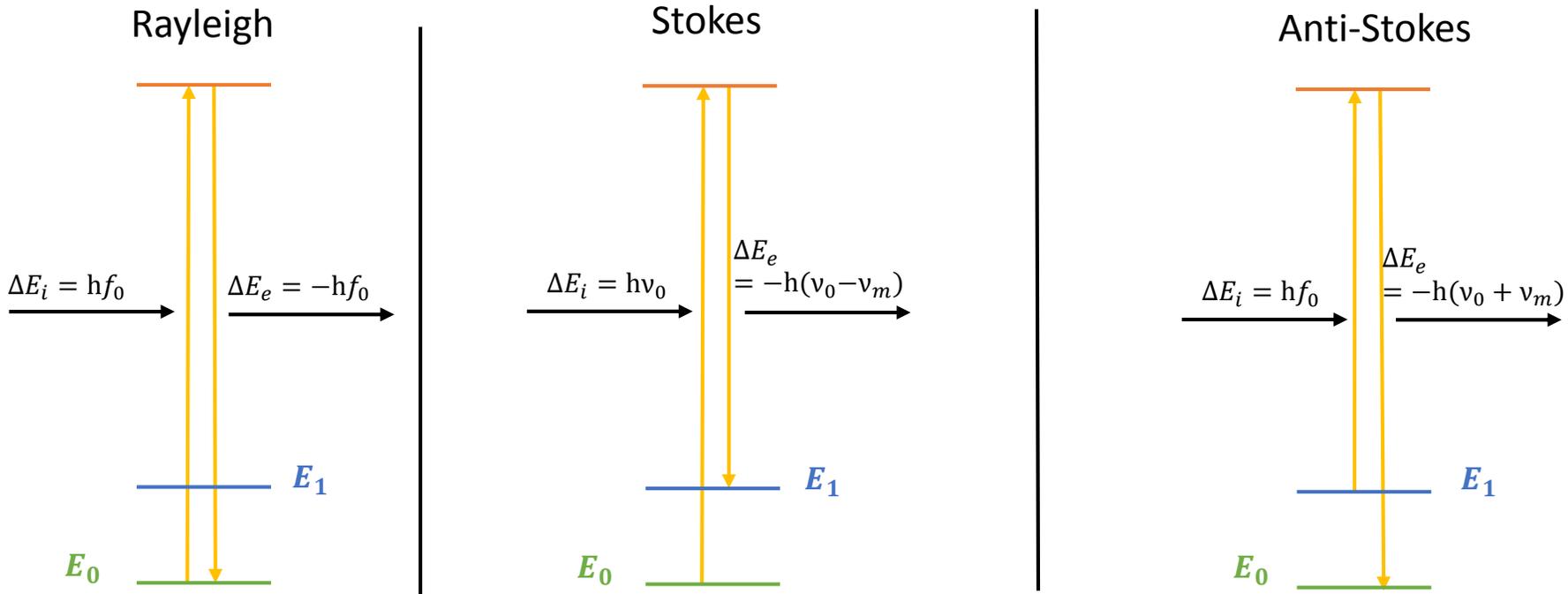
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<sup>2</sup>Centro Brasileiro de Pesquisas Físicas (CBPF)

# Objetivo

- Compreender o efeito Raman;
- Estudar as componentes do espectrômetro;
- Analisar a composição química e orientação cristalina de óxidos metálicos, com foco no ZnO;
- Investigar através dos modos de vibração Raman a dependência da fase cristalina e espessura do filme fino de ZnO.

# Espalhamento Raman

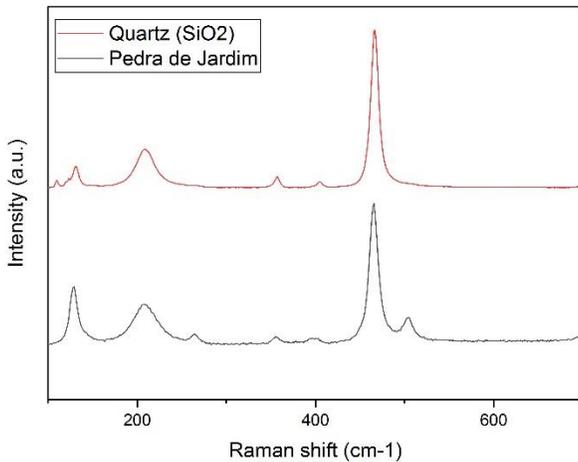
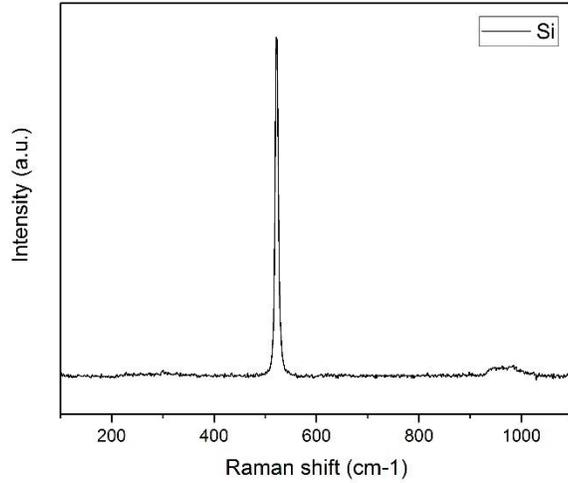


$$P = \alpha E_0 \cos(2\pi\nu_0 t)$$

$$P = \alpha_0 E_0 \cos(2\pi\nu_0 t) + \frac{1}{2} \left( \frac{\partial \alpha}{\partial q} \right)_{q_0} q_0 E_0 \cos[2\pi(\nu_0 - \nu_m)t] + \frac{1}{2} \left( \frac{\partial \alpha}{\partial q} \right)_{q_0} q_0 E_0 \cos[2\pi(\nu_0 + \nu_m)t]$$

# Aplicações da Espectroscopia Raman

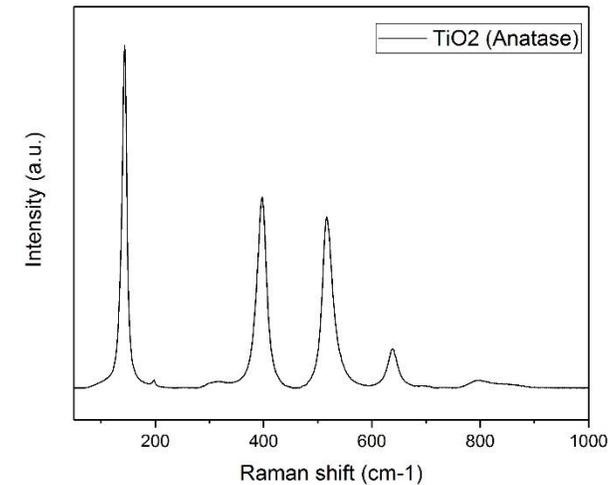
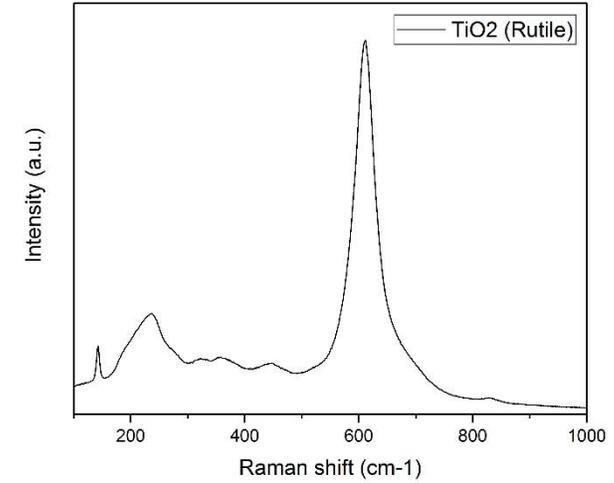
Identificação de materiais



<http://rruff.info/quartz/display=default/R040031>



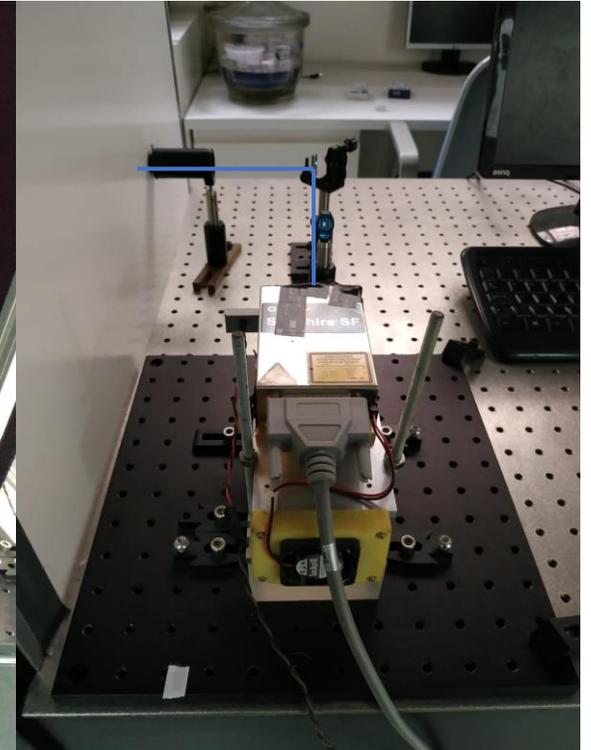
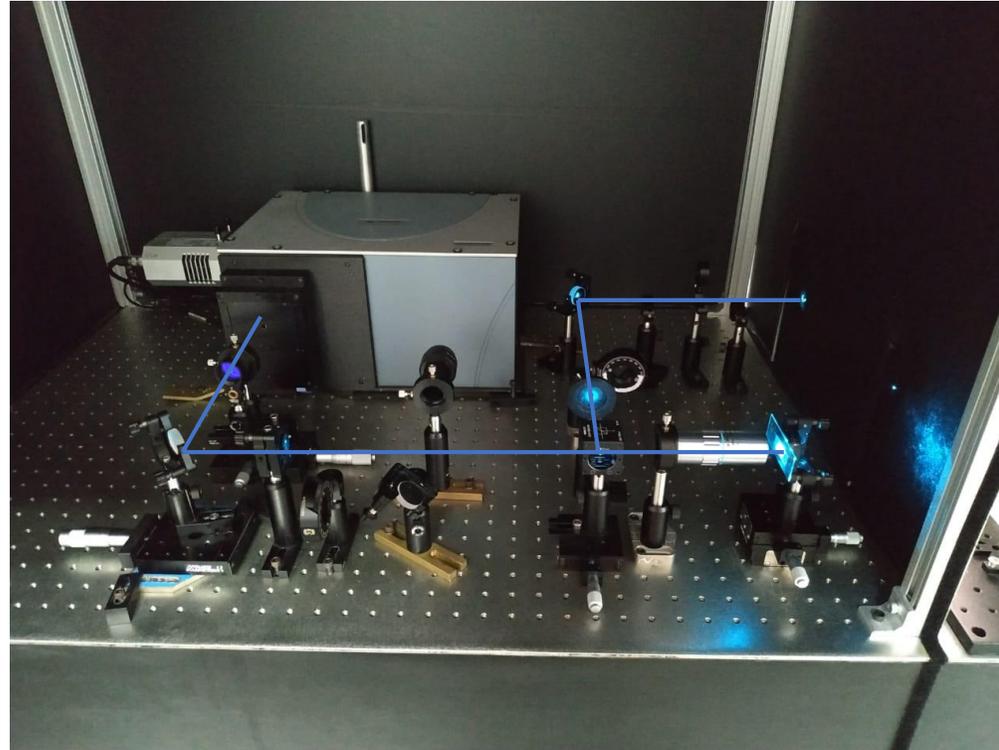
Distinguir materiais de mesma composição química



<http://rruff.info/anatase/display=default/R060277>

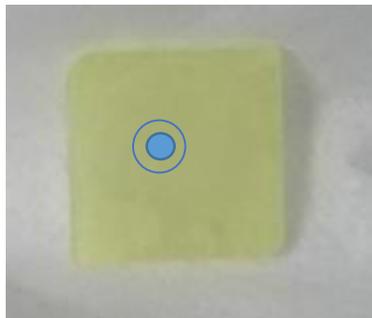
# Instrumentação

- Laser Sapphire 488nm;
- Filtro laserline;
- Filtros de densidade neutra;
- Filtro dicróico;
- Filtro edge;
- Lente objetiva 50x;
- Polarizadores;
- Grade de difração;
- Detector CCD;
- Conjunto de espelhos a 45°;
- Conjunto de íris.

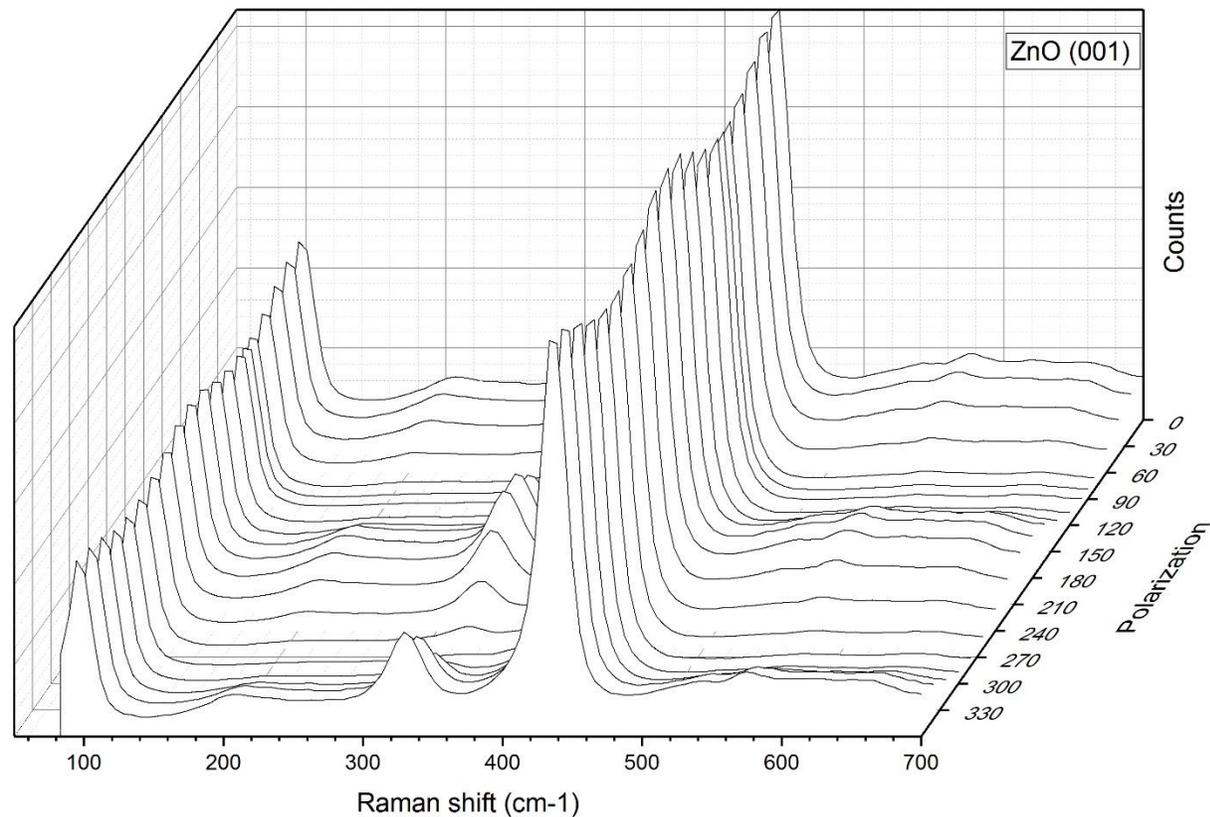
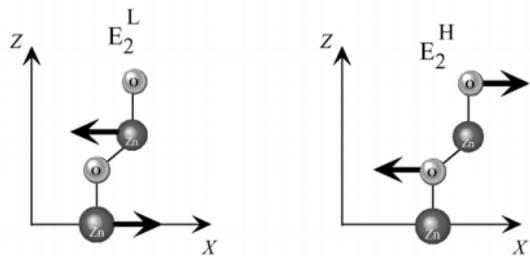
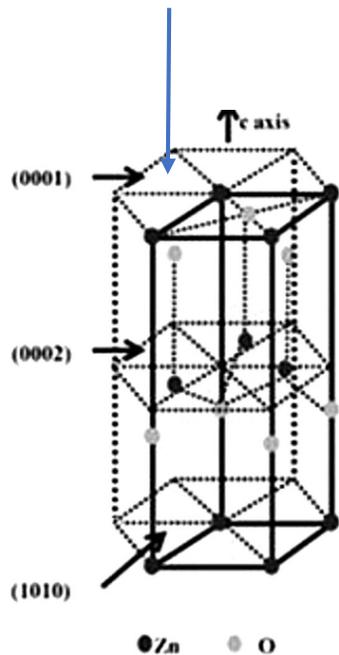
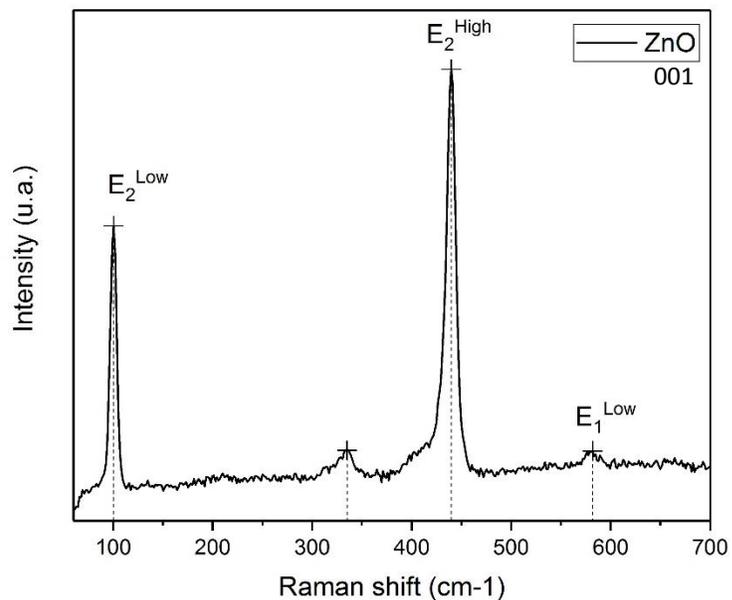


# Espectroscopia Raman Polarizada em ZnO

Plano Basal

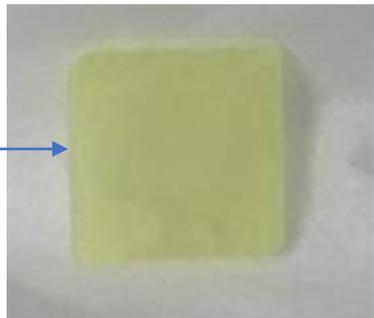


Modo de vibração	cm-1
E <sub>2</sub> (Low)	98,47
E <sub>2</sub> (High)	437,82

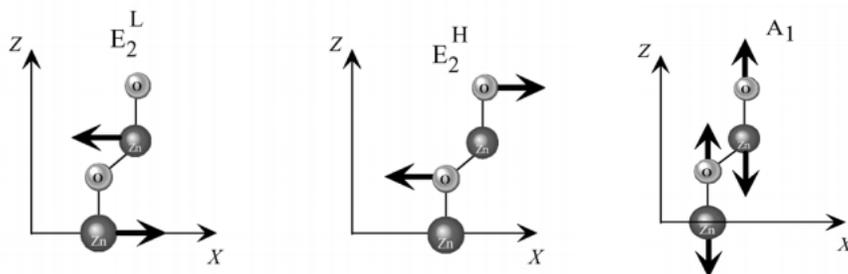
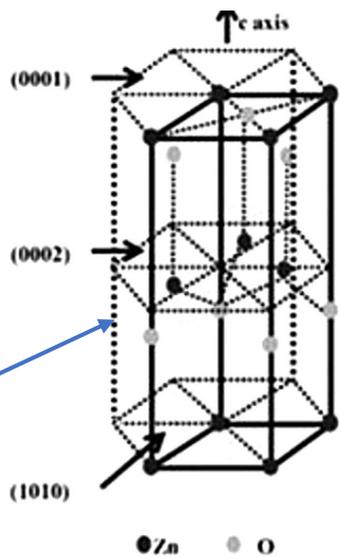
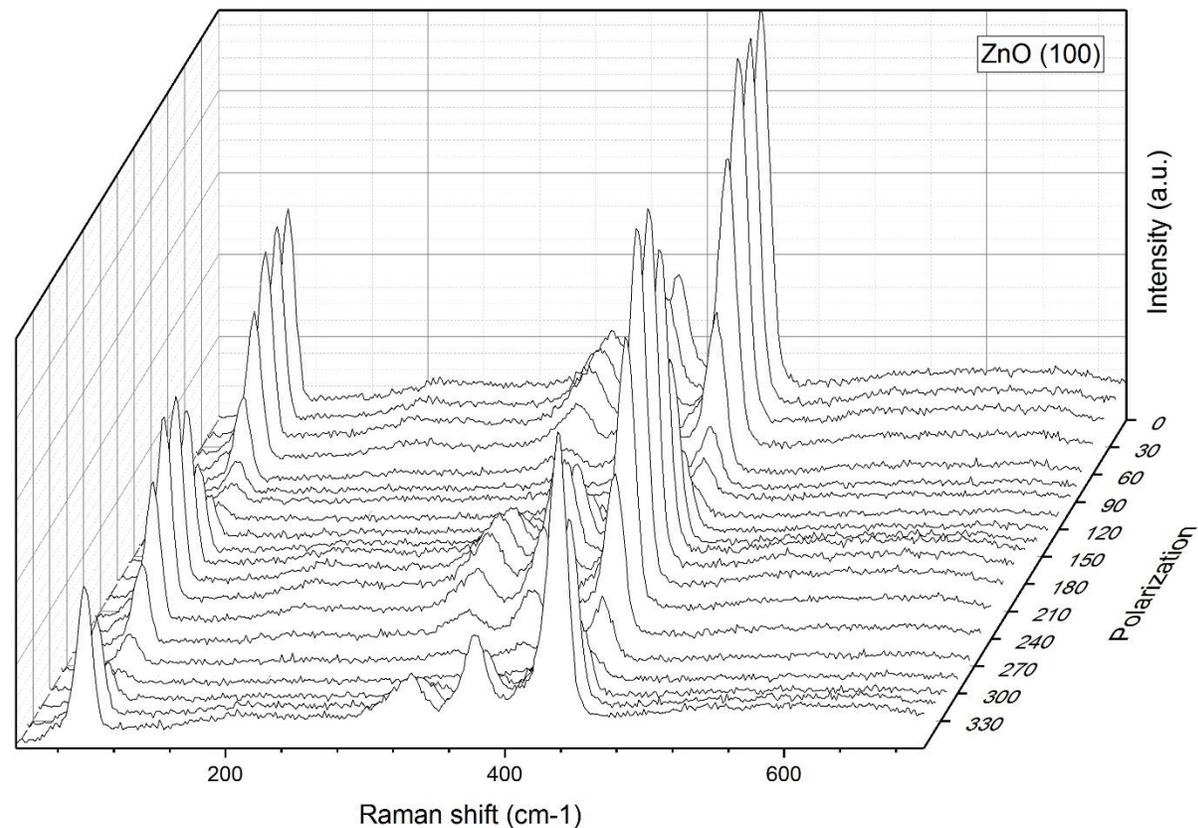
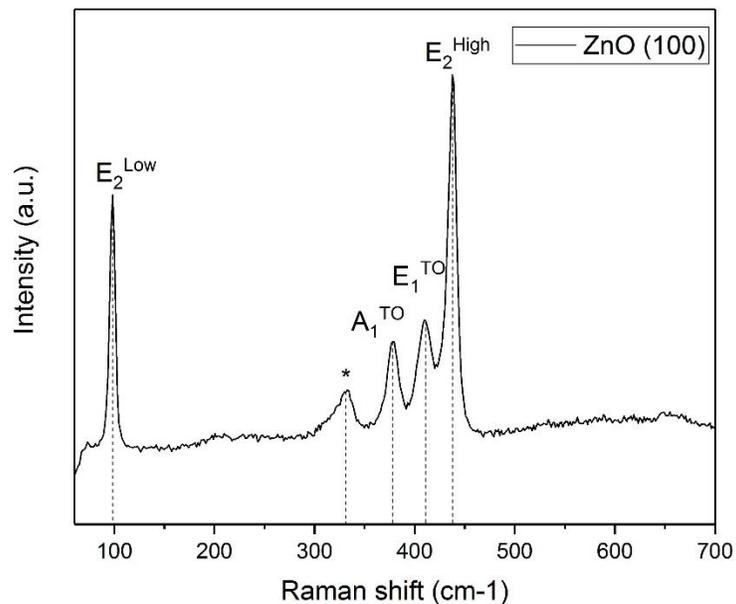


# Espectroscopia Raman Polarizada em ZnO

Plano Edge

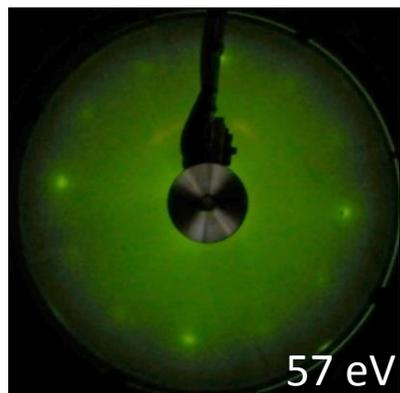
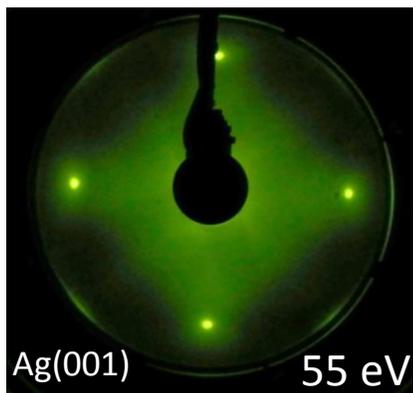
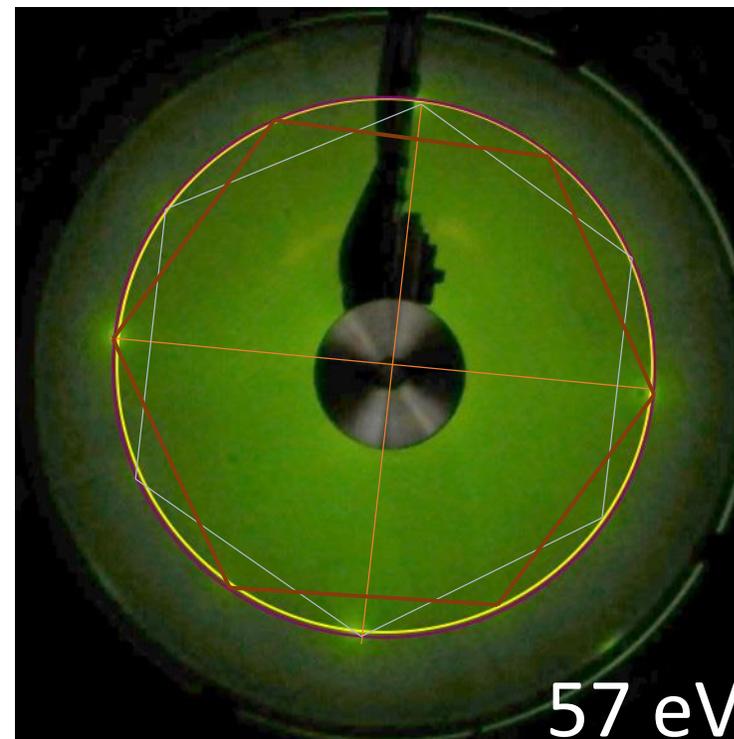
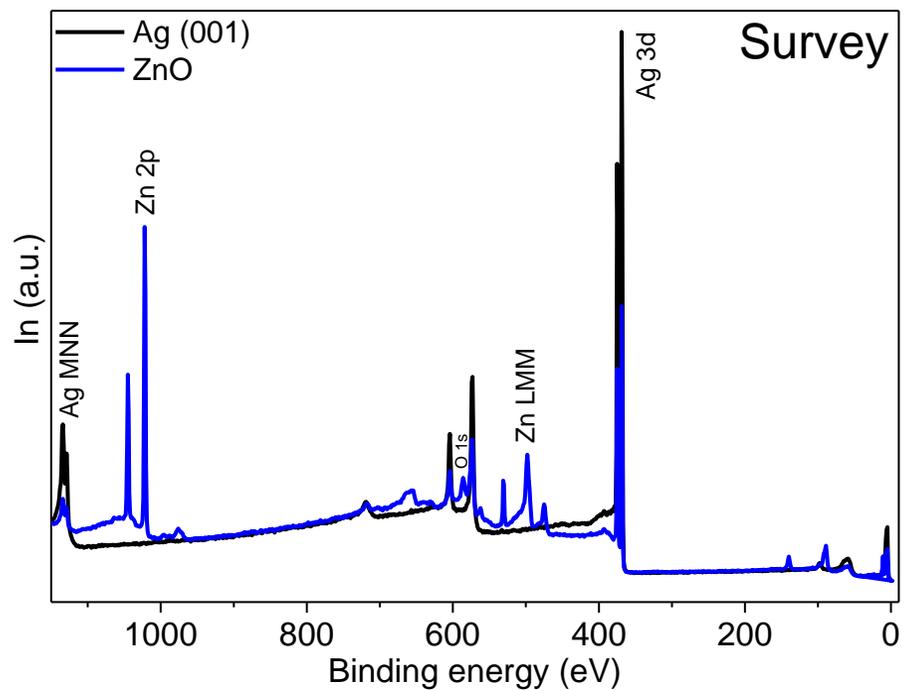


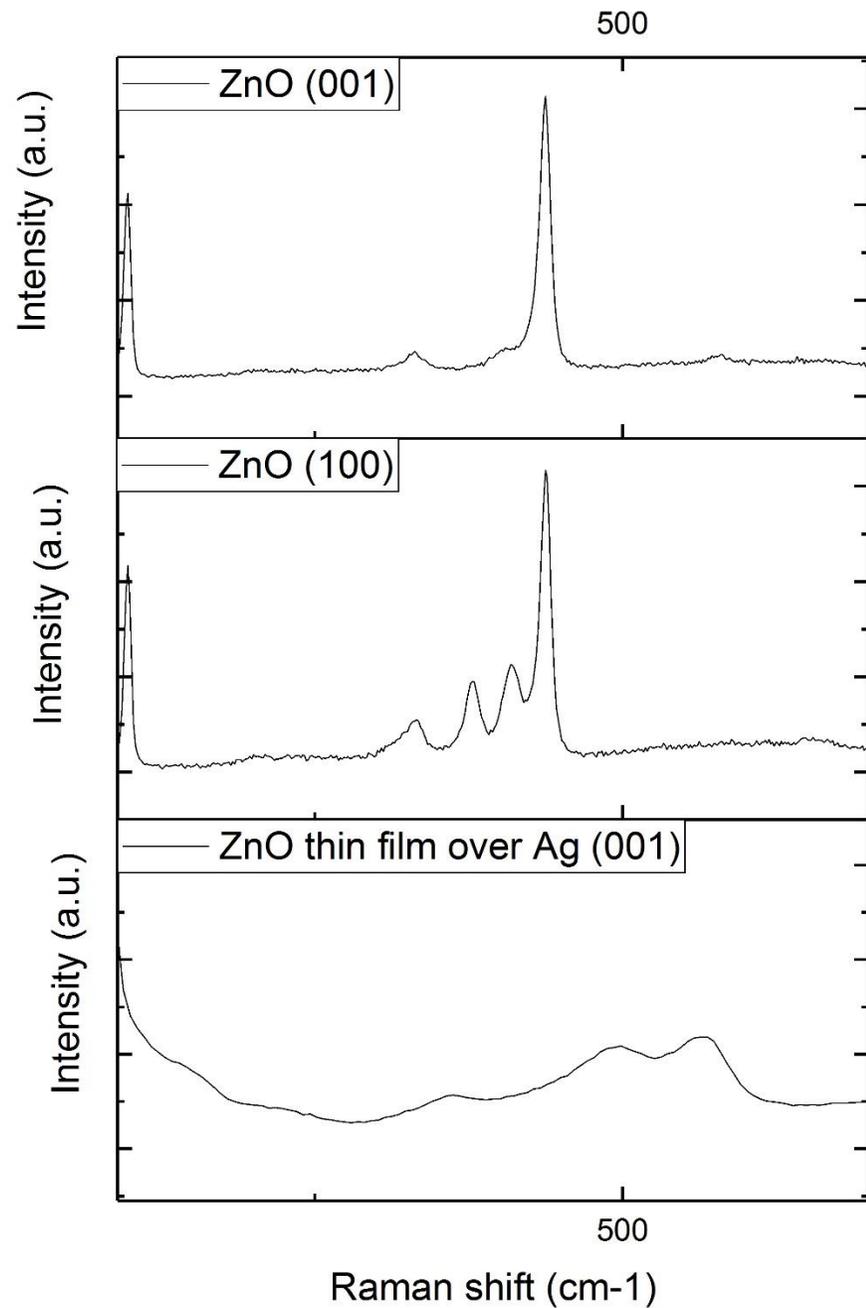
Modo de vibração	cm-1
E2(Low)	94
E2(High)	437,62
E1(TO)	409,37
A1(TO)	378,01



# Resultados do filme fino de ZnO

XPS/LEED





Monocrystal ZnO (100)

$$\frac{E_2^{High}}{E_1^{TO}} = 1,07$$

$$\frac{E_2^{High}}{A_1^{TO}} = 1,15$$

Filme ZnO sobre Ag (001)

$$\frac{E_2^{High}}{E_1^{TO}} = 1,14$$

$$\frac{E_2^{High}}{A_1^{TO}} = 1,15$$

Modo de vibração	cm-1
E2High	569
E1(TO)/A1(TO)	498,83

# Conclusão

- O equipamento para a Espectroscopia Raman funciona satisfatoriamente;
- Estudamos um monocristal de ZnO a fim de obter os modos de vibração para cada face;
- É possível descobrir a orientação cristalina do monocristal através da polarização da luz incidente;
- É possível detectar o filme de ZnO através da Espectroscopia Raman, porém são necessárias mais análises de dados para melhores conclusões.

**#UERJRESISTE**



Obrigado!