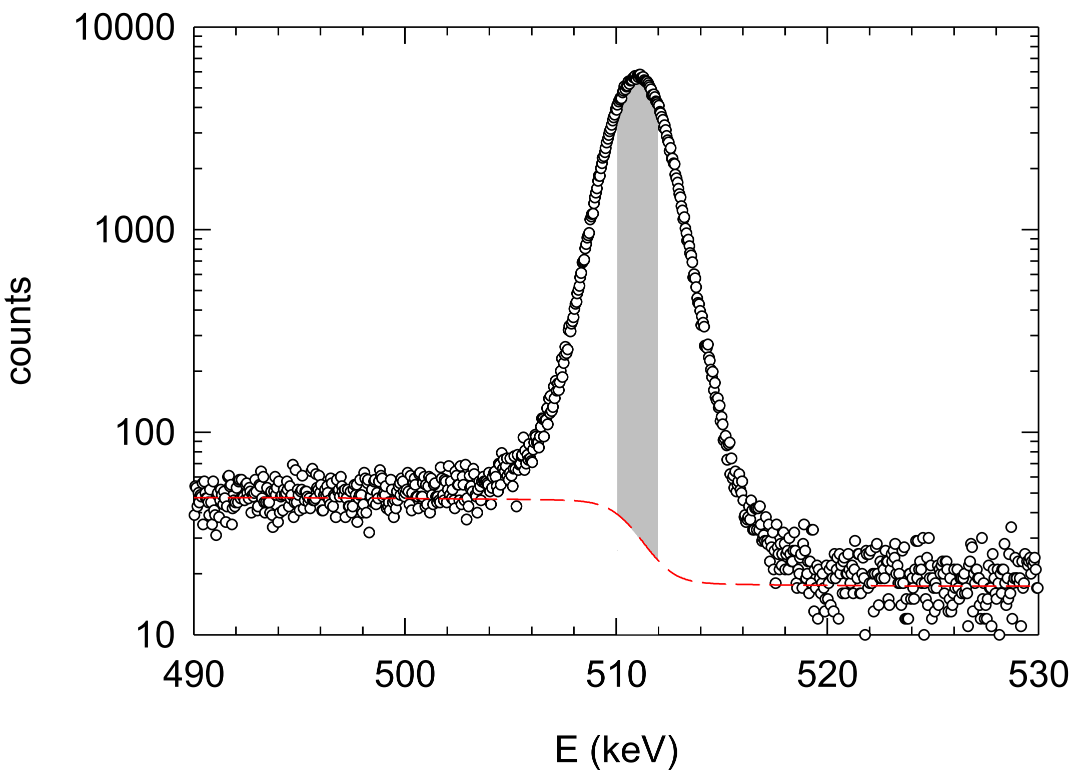
Doppler broadening – shape parameters



• S parameter

$$S = A_{centr} / A_{tot}$$

$$S = \eta_B S_B + \sum_i \eta_{D_i} S_{D_i}$$

free e^+

e^+ trapped at defects

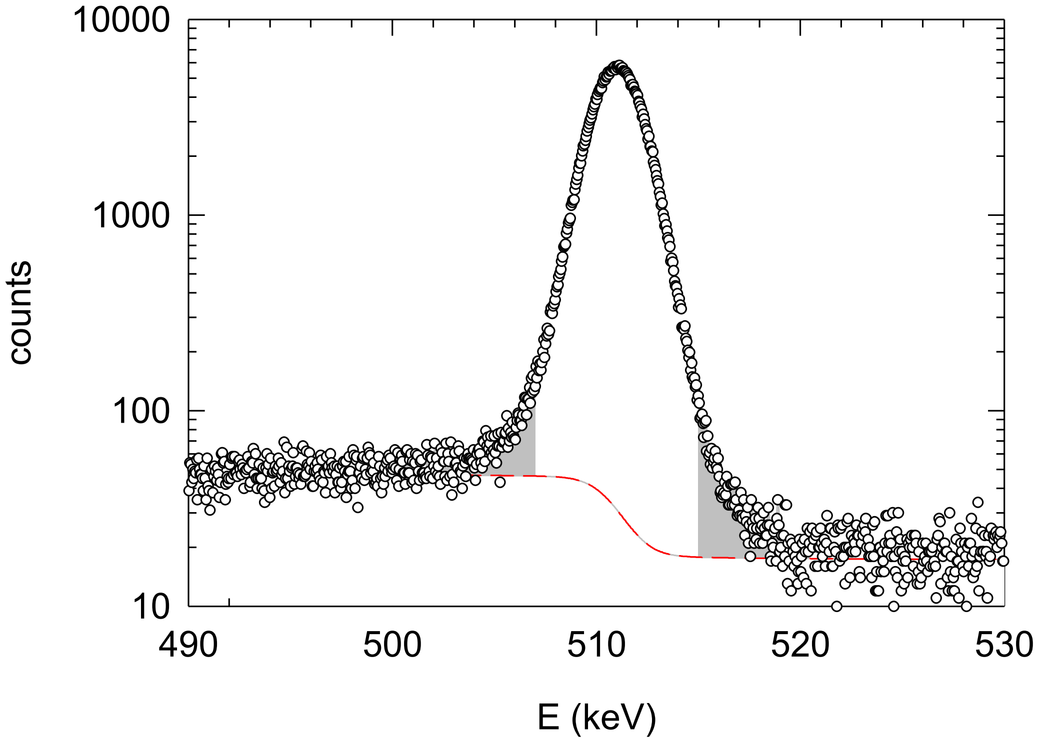
• reference sample: $S_0 \approx 0.5$

• normalization: S / S_0

• S – a measure of e^+ annihilations with valence e^- (low ΔE)

• increase of defect concentration → increase of S parameter

Doppler broadening – shape parameters



• W parameter

$$W = A_{wings} \,/\, A_{tot}$$

$$W = \eta_B W_B + \sum_i \eta_{D_i} W_{D_i}$$

free e^+

e^+ trapped at defects

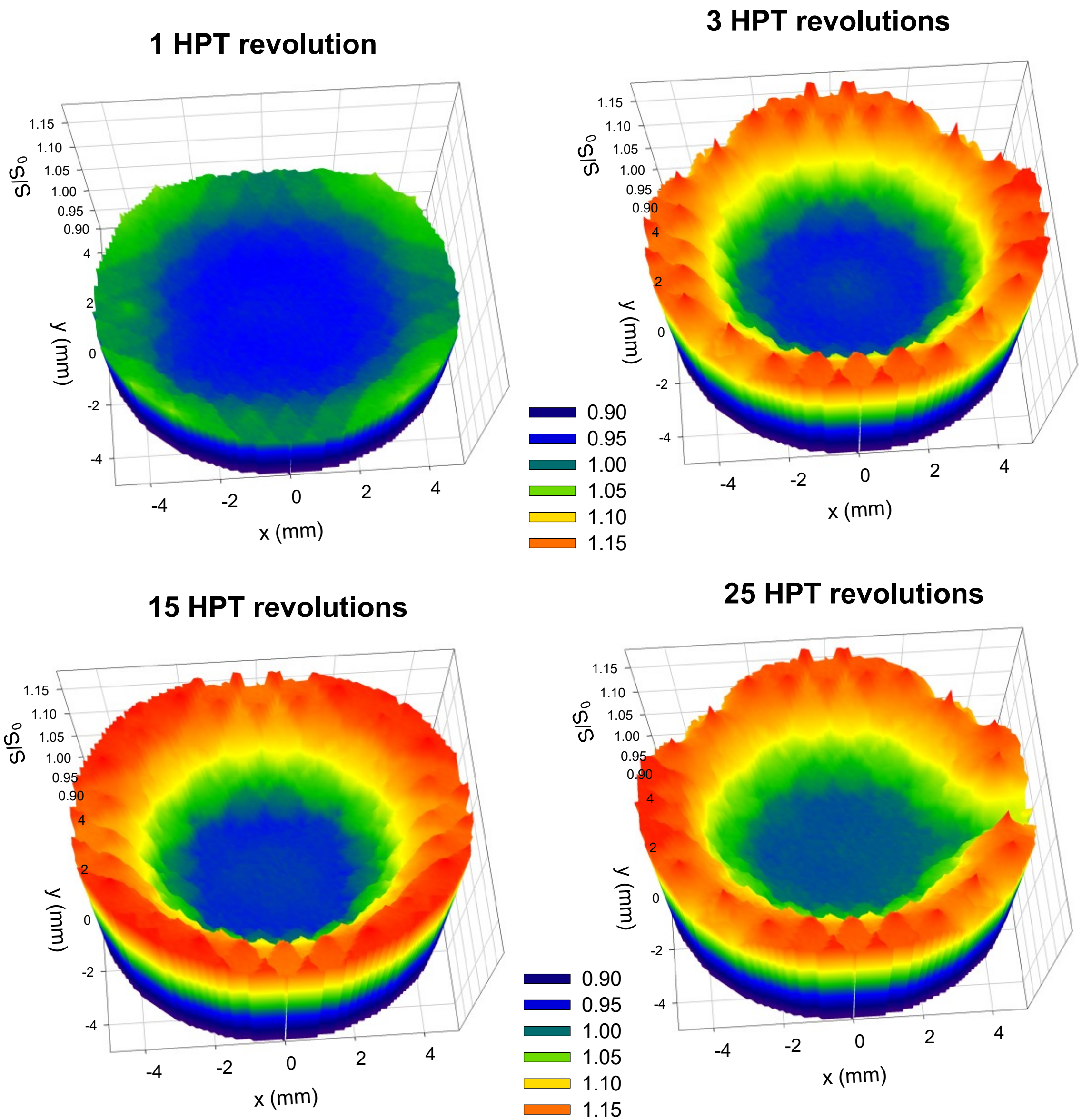
• reference sample: $W_0 \approx 0.03$

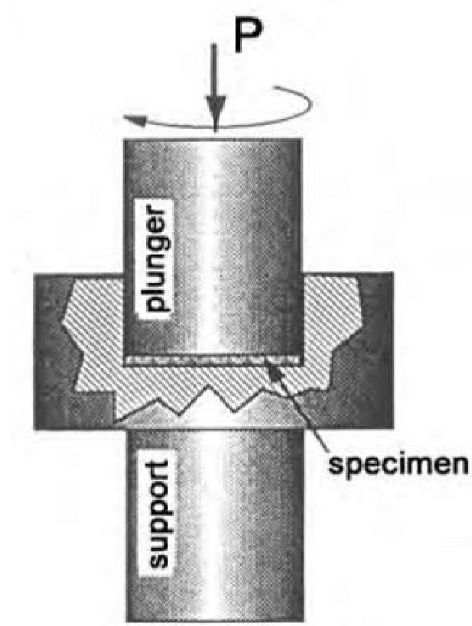
• normalization: $W \,/\, W_0$

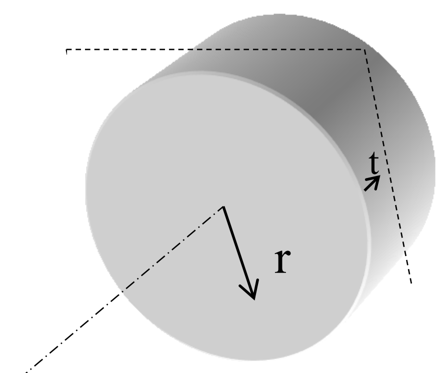
• W – a measure of e^+ annihilations with core e^- (high ΔE)

• increase of defect concentration → decrease of W parameter

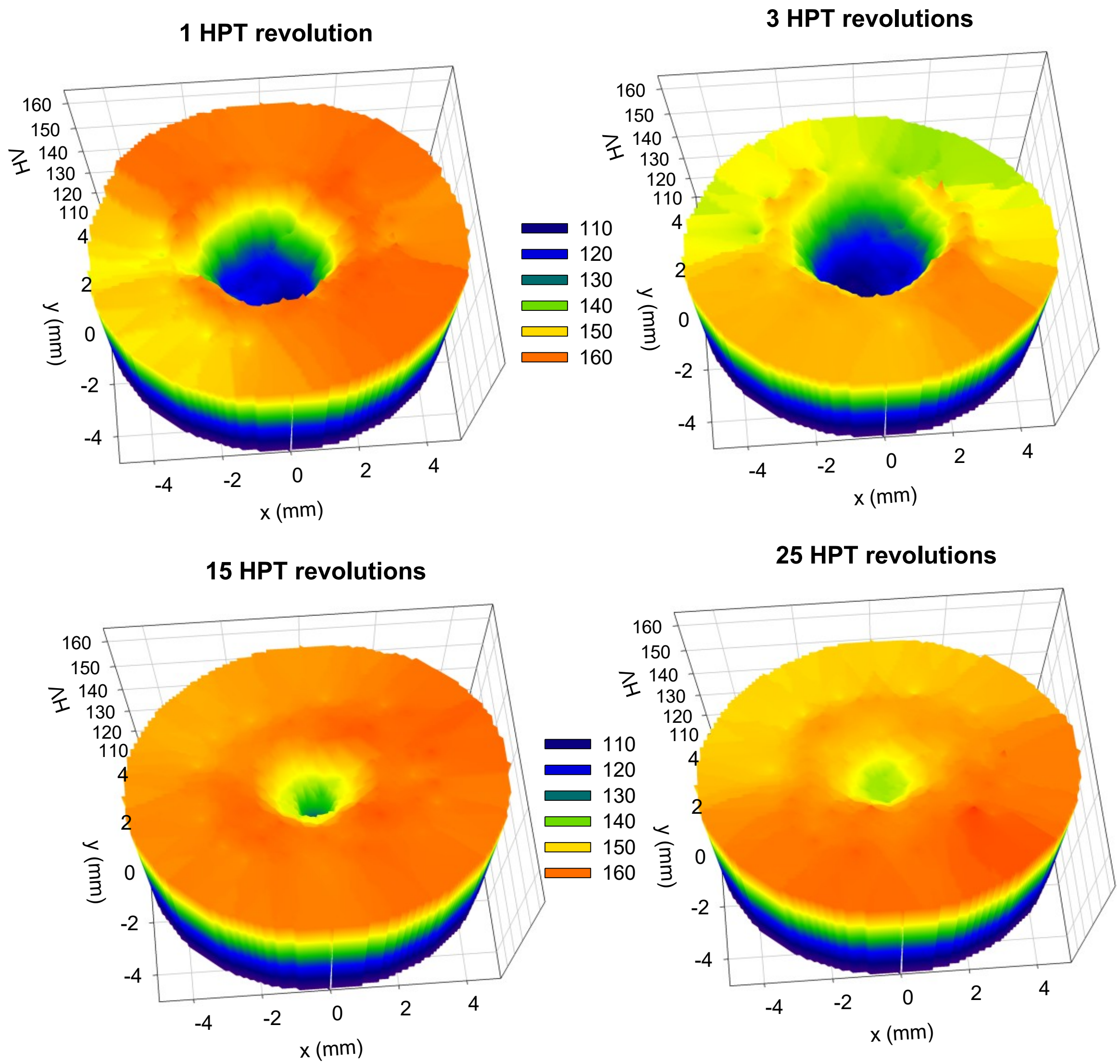
Doppler broadening – shape parameters

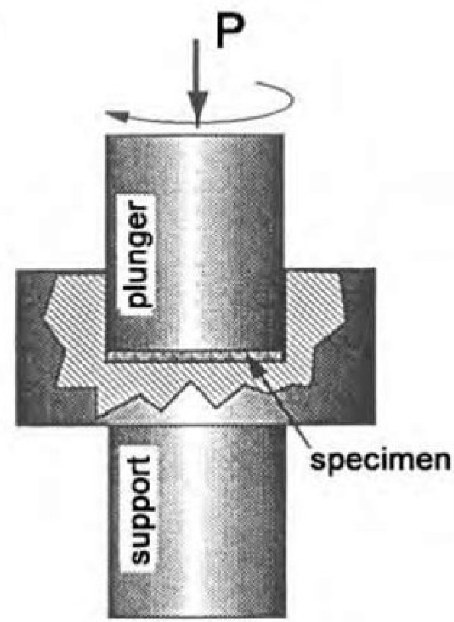


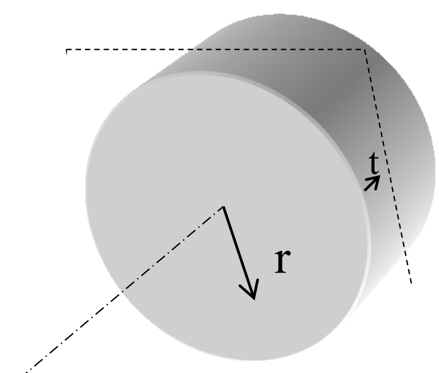




Comparison with microhardnes

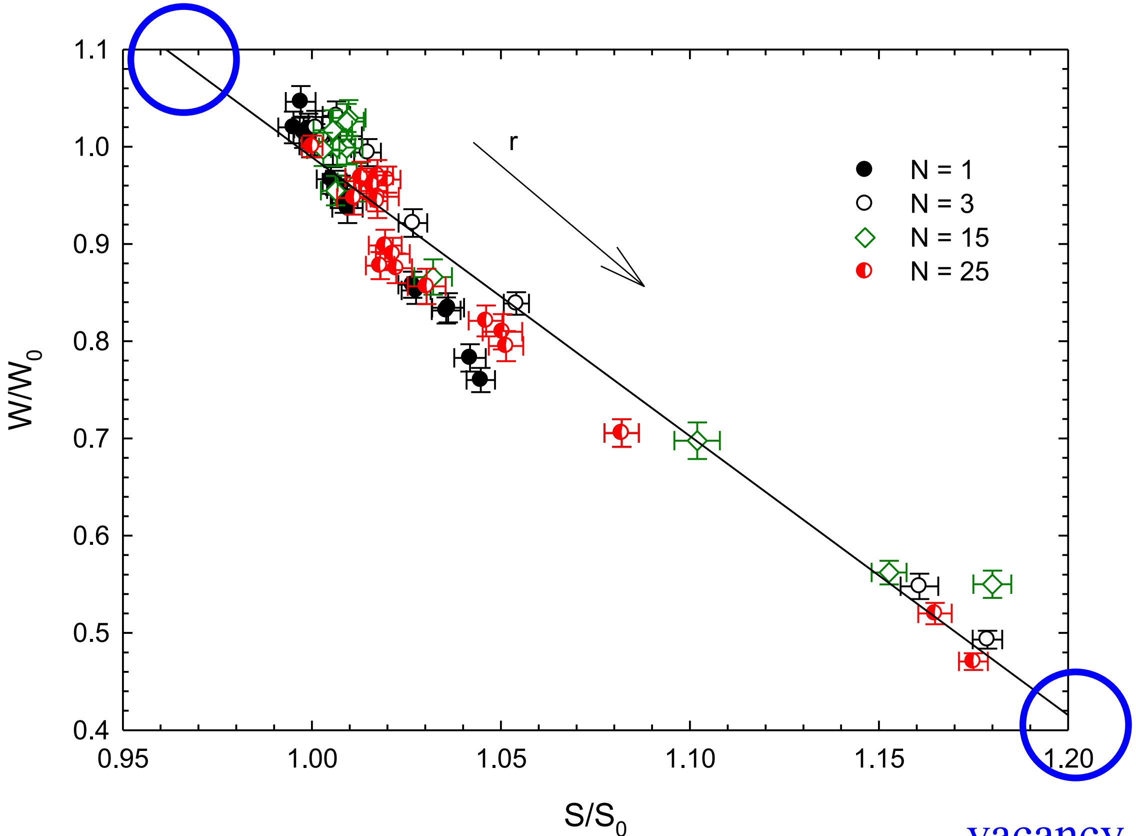






S-W plot

dislocations



vacancy clusters

- saturated trapping
- two types of defects:
  - dislocations
  - vacancy clusters

$$S = (1-\eta_{cl})S_{disl} + \eta_{cl} S_{cl}$$

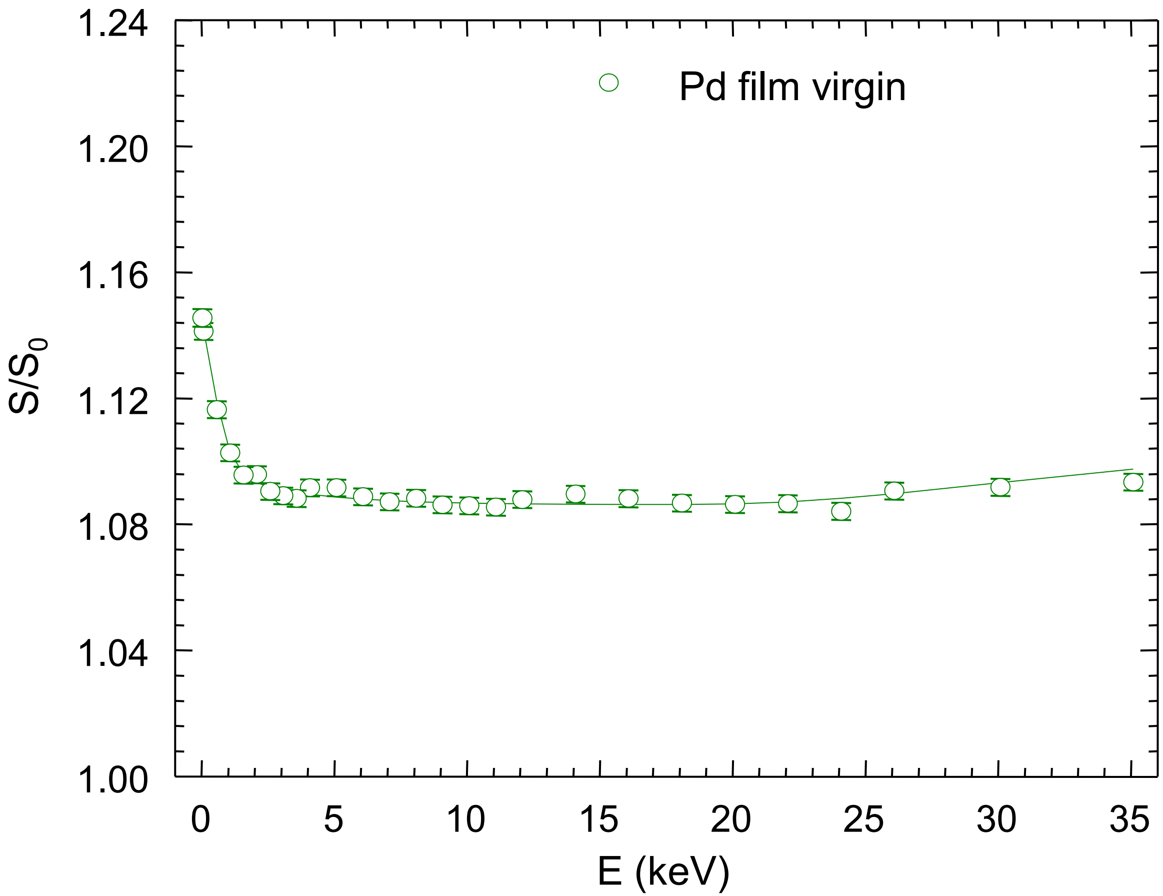
$$W = (1-\eta_{cl})W_{disl} + \eta_{cl} W_{cl}$$

$$R \equiv \frac{S - S_d}{W - W_d} = \text{konst}$$

Pd films

Pd film, thickness 1080 nm, virgin state

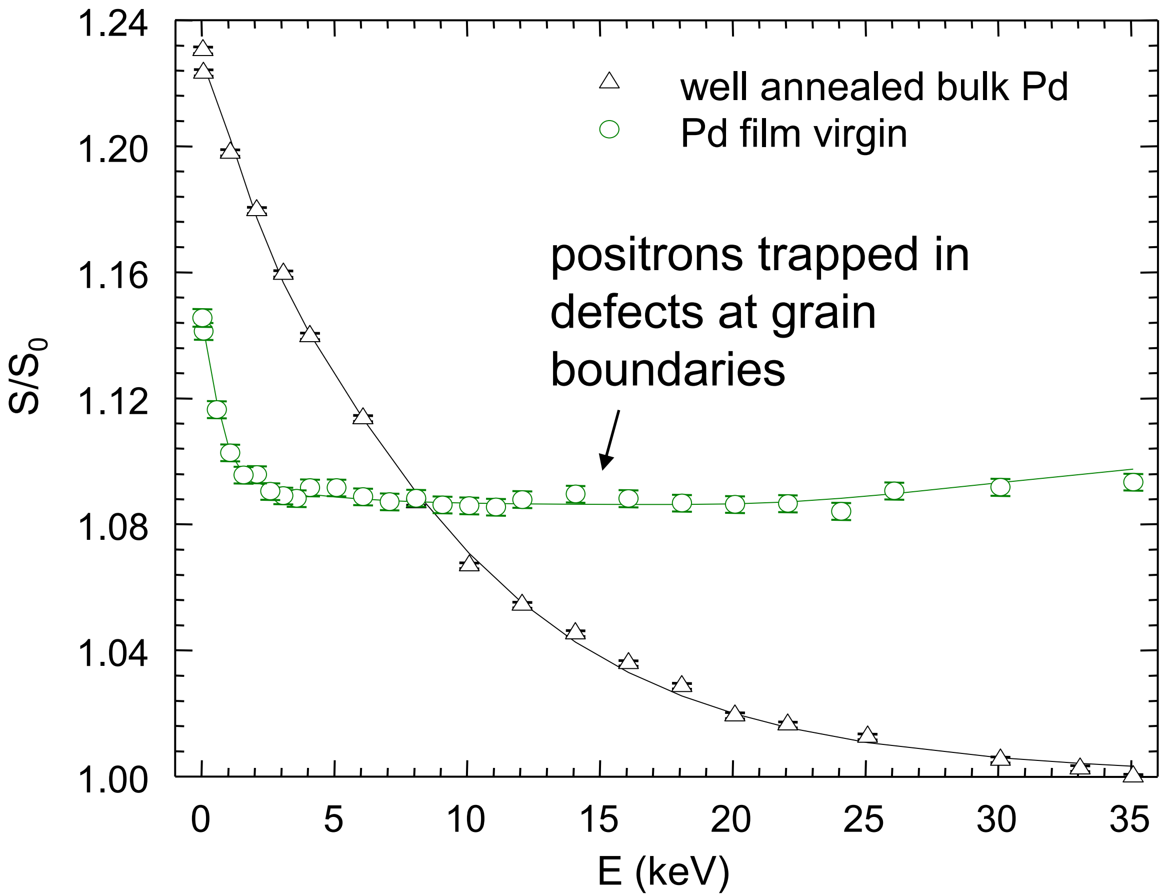
- VEPFIT (model 5) two layers: (i) Pd film, (ii) sapphire substrate
- thin film, Pd layer: $L_+ = (41 \pm 7)$ nm

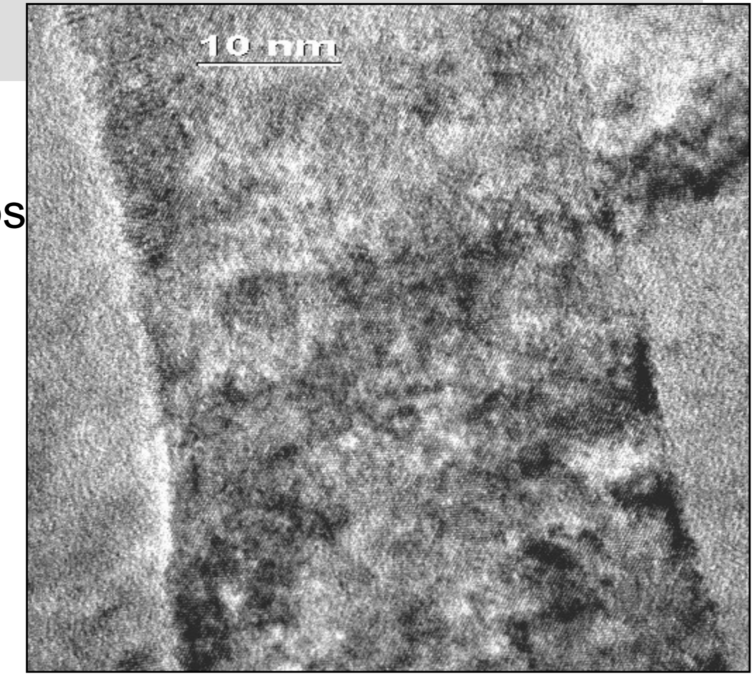


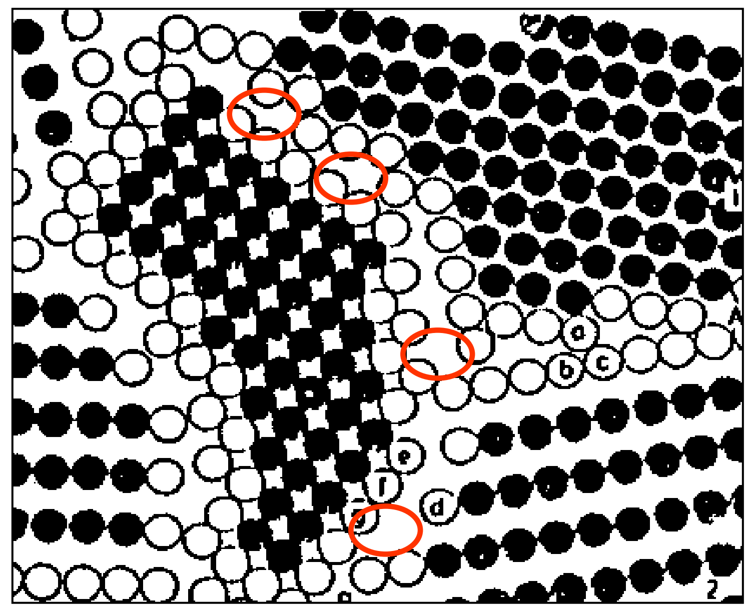
Pd films

Pd film, thickness 1080 nm, virgin state

- VEPFIT (model 5) two layers: (i) Pd film, (ii) sapphire subs
- thin film, Pd layer: $L_+ = (41 \pm 7)$ nm
- well annealed bulk Pd layer: $L_+ = (151 \pm 4)$ nm

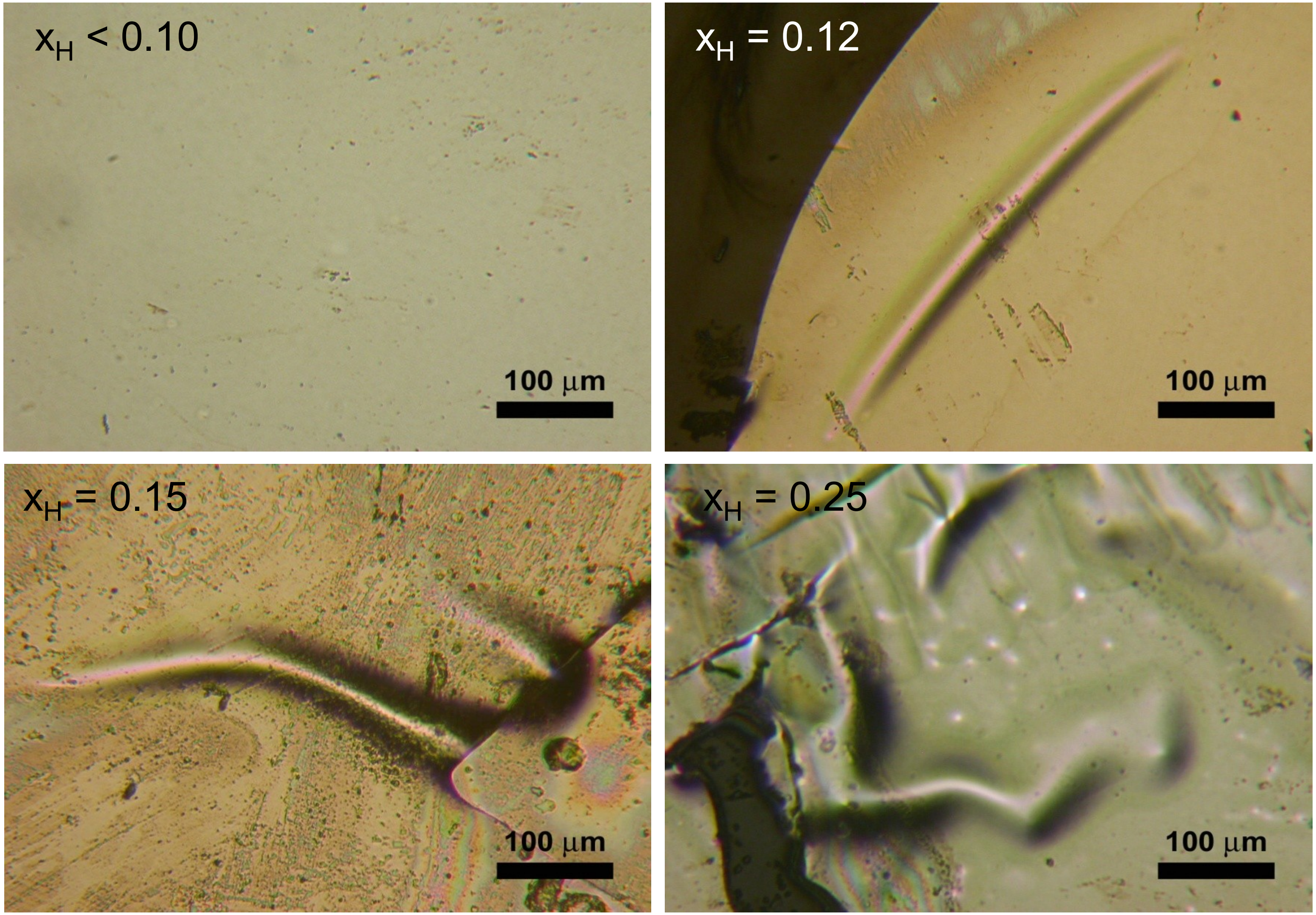






Hydrogen-induced buckling

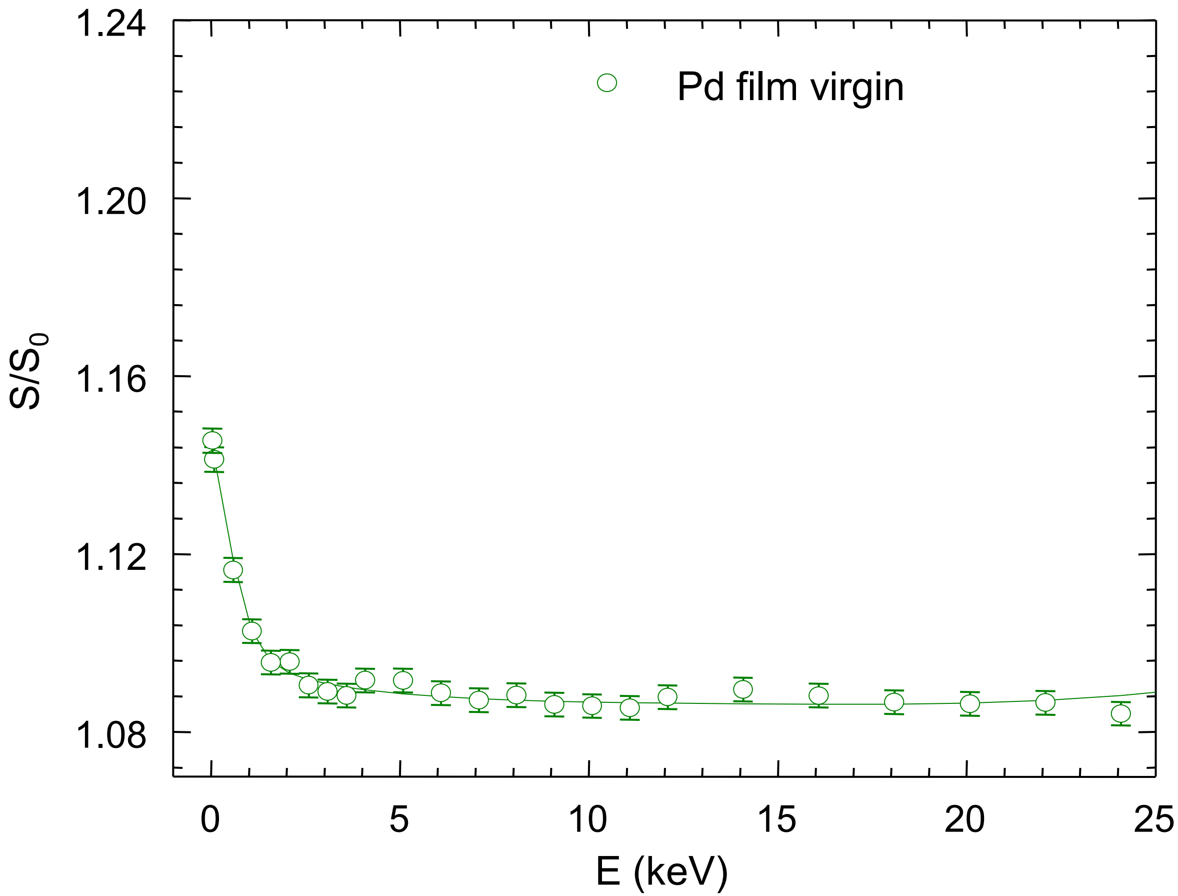
Pd film, thickness 1080 nm, step-by-step loaded with hydrogen



Pd films

Pd film, thickness 1080 nm, step-by-step loaded with hydrogen

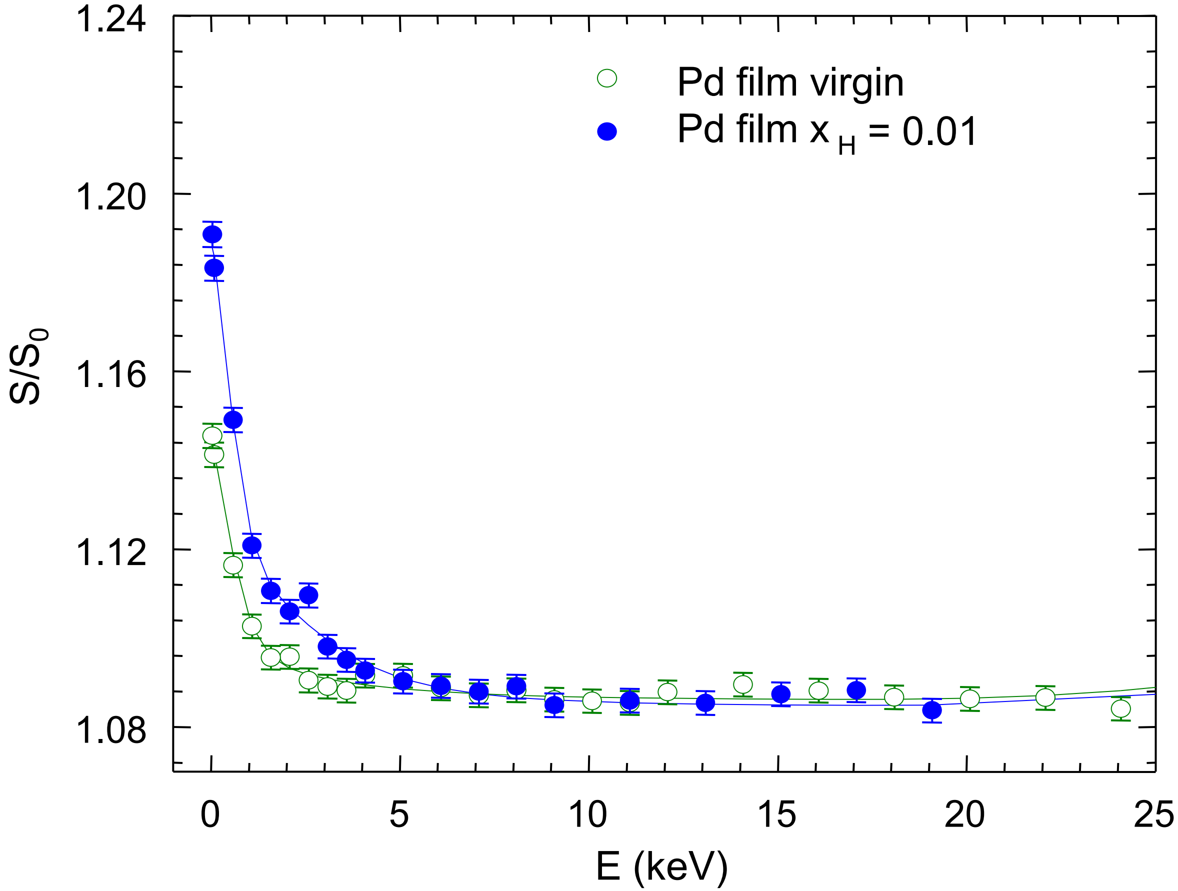
- VEPFIT (model 5) two layers: (i) Pd film, (ii) sapphire substrate



Pd films

Pd film, thickness 1080 nm, step-by-step loaded with hydrogen

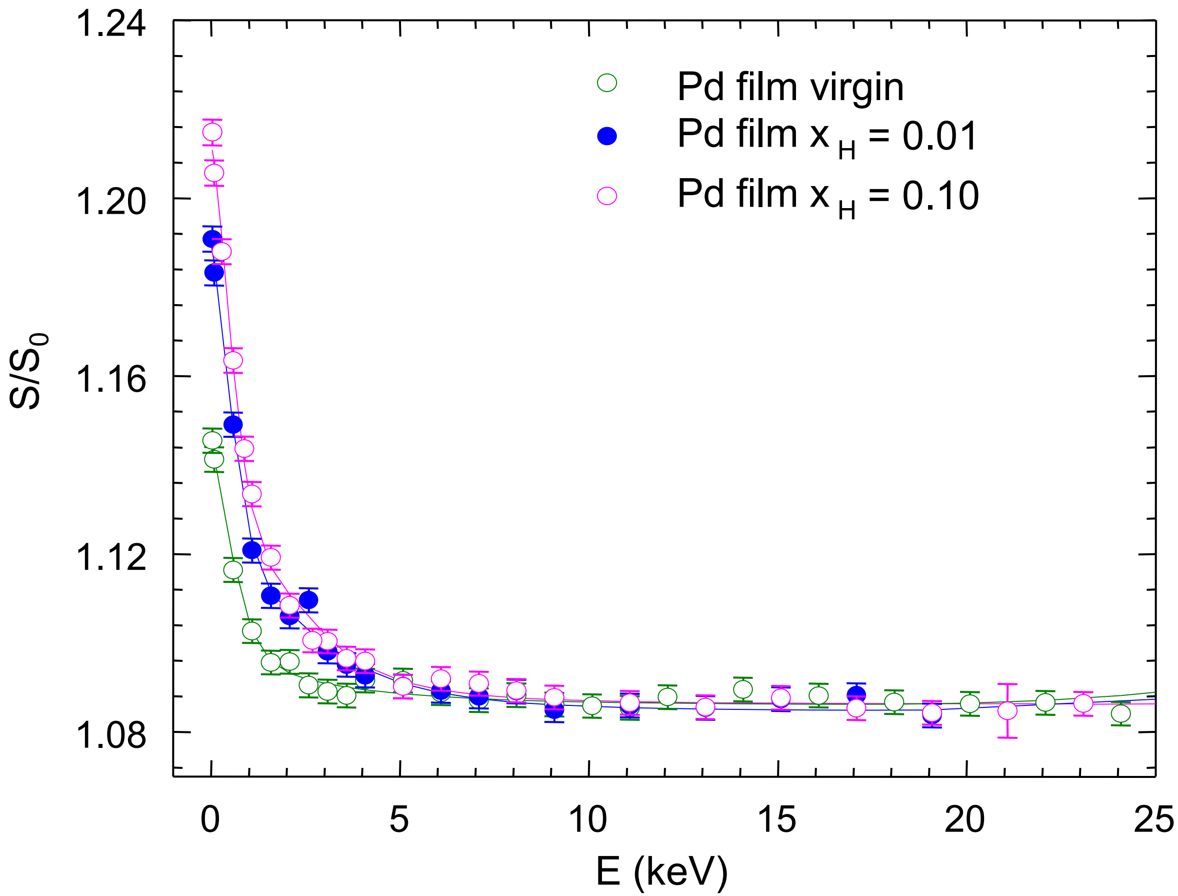
- VEPFIT (model 5) two layers: (i) Pd film, (ii) sapphire substrate



Pd films

Pd film, thickness 1080 nm, step-by-step loaded with hydrogen

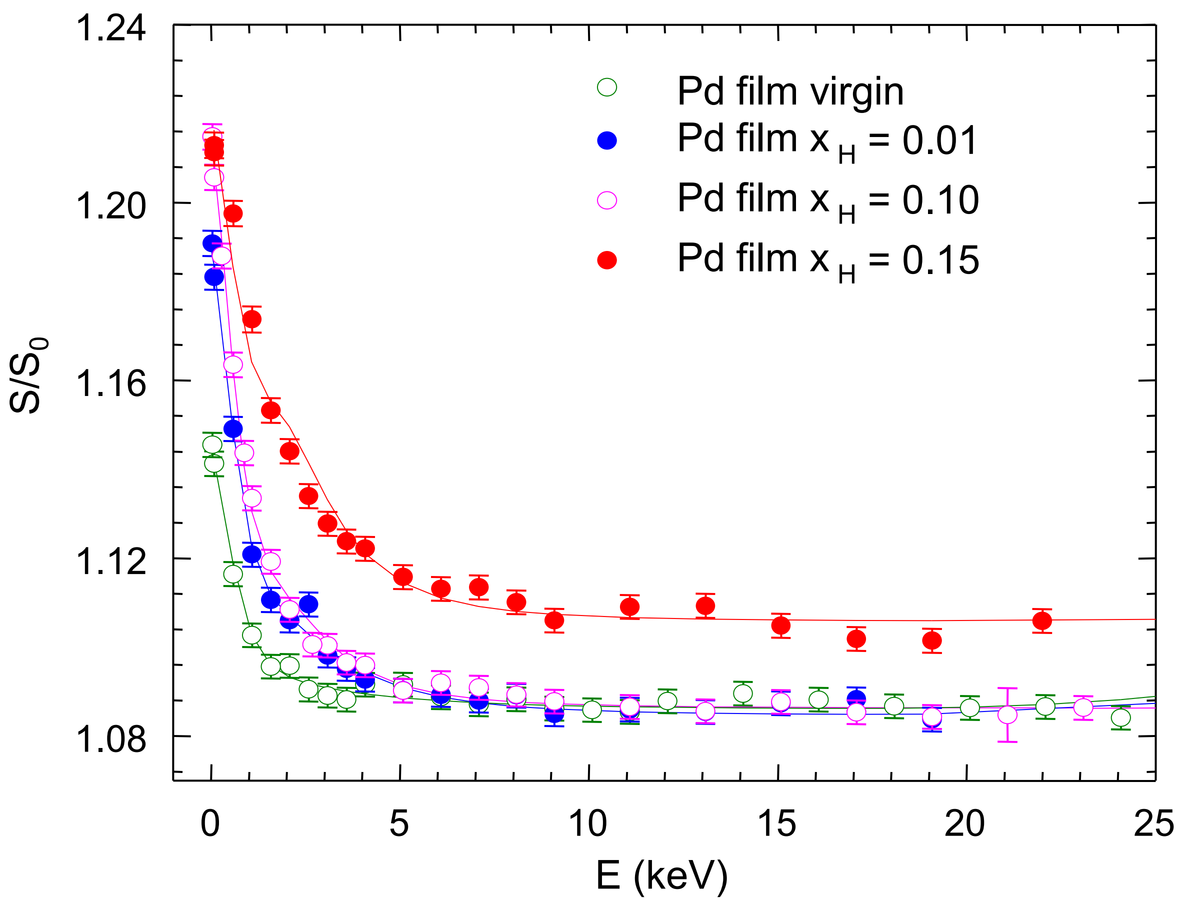
• VEPFIT (model 5) two layers: (i) Pd film, (ii) sapphire substrate



Hydrogen loaded Pd films

Pd film, thickness 1080 nm, step-by-step loaded with hydrogen

• VEPFIT (model 5) two layers: (i) Pd film, (ii) sapphire substrate

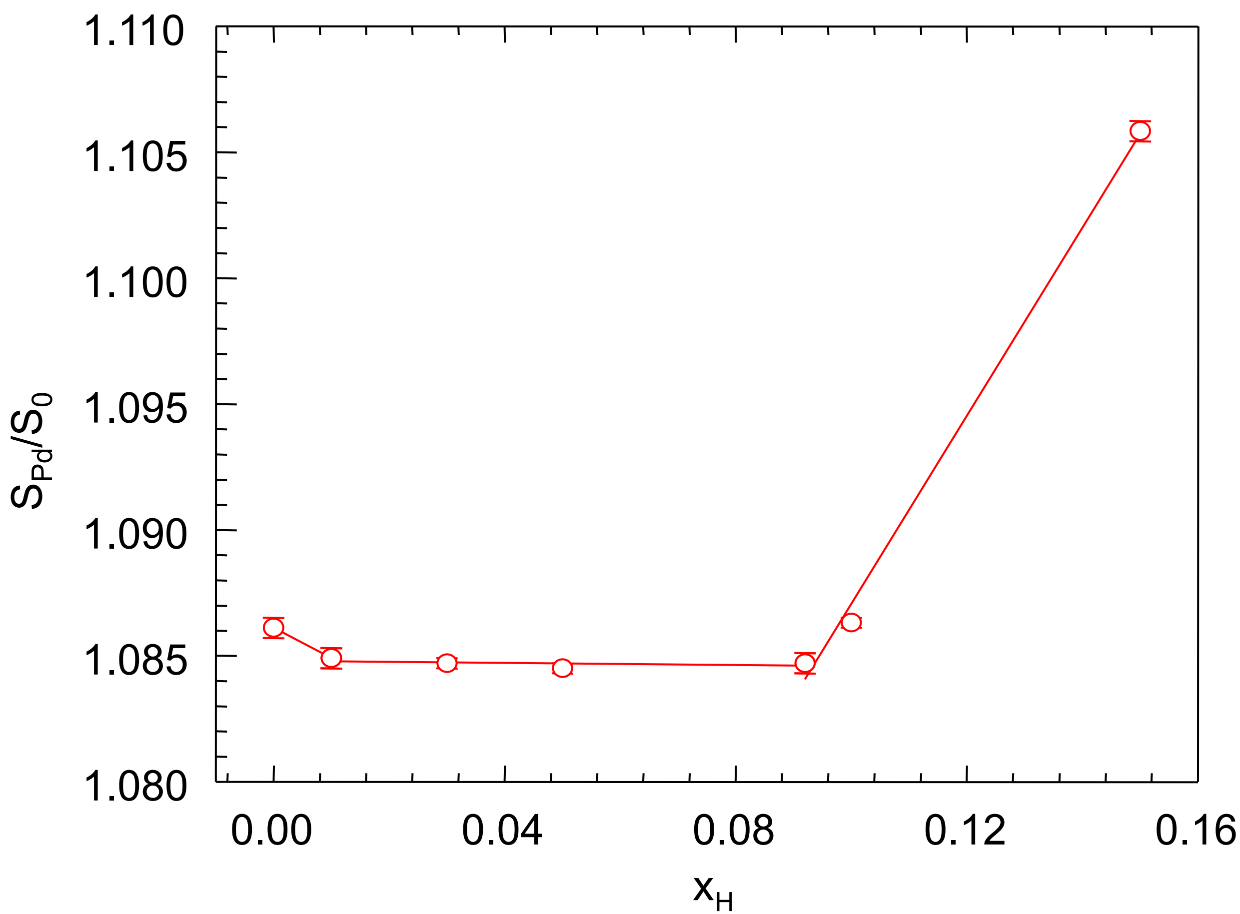


x_H = 0.15

Hydrogen loaded Pd films

Pd film, thickness 1080 nm, step-by-step loaded with hydrogen

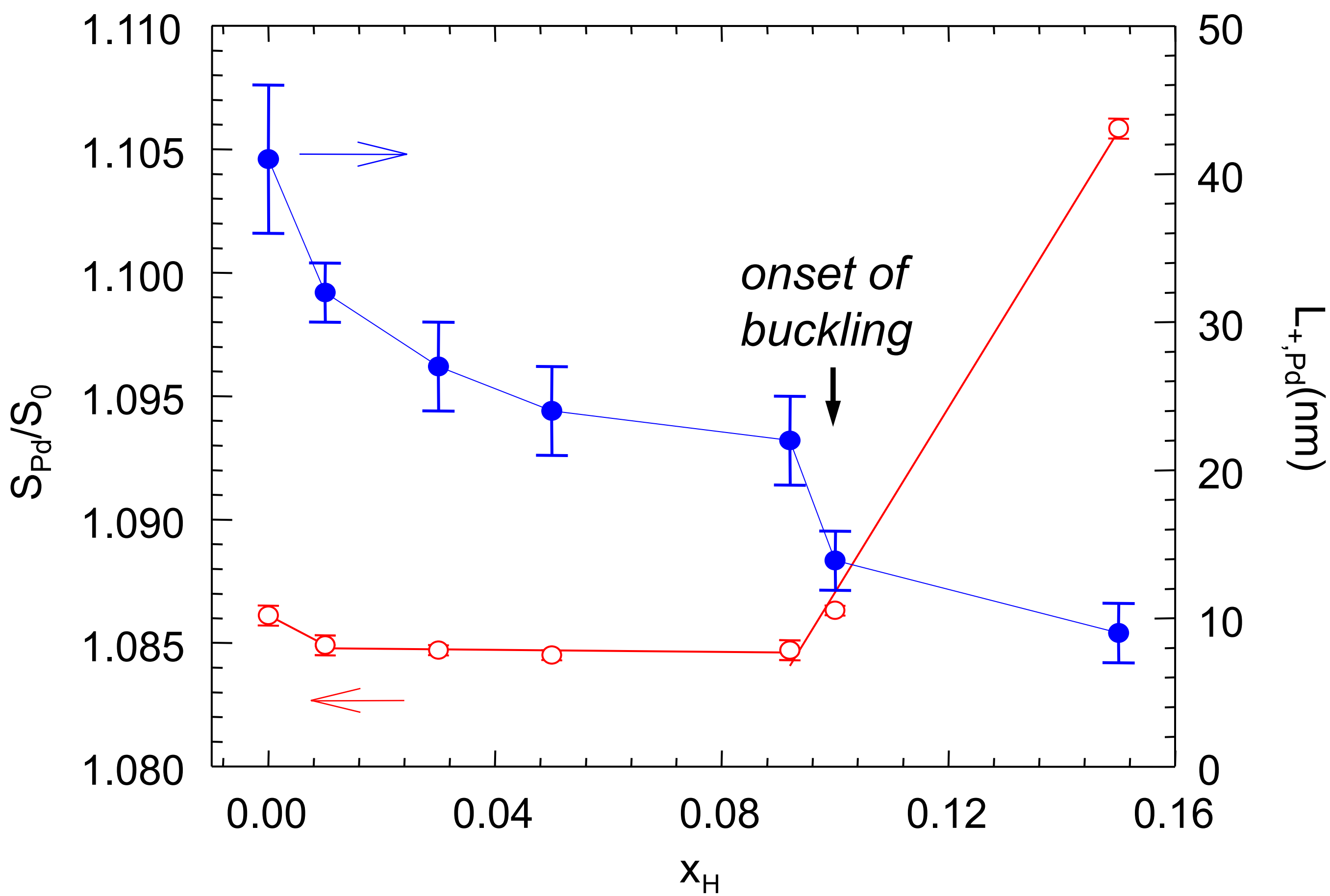
- S_{Pd} - parameter for the Pd layer



Hydrogen loaded Pd films

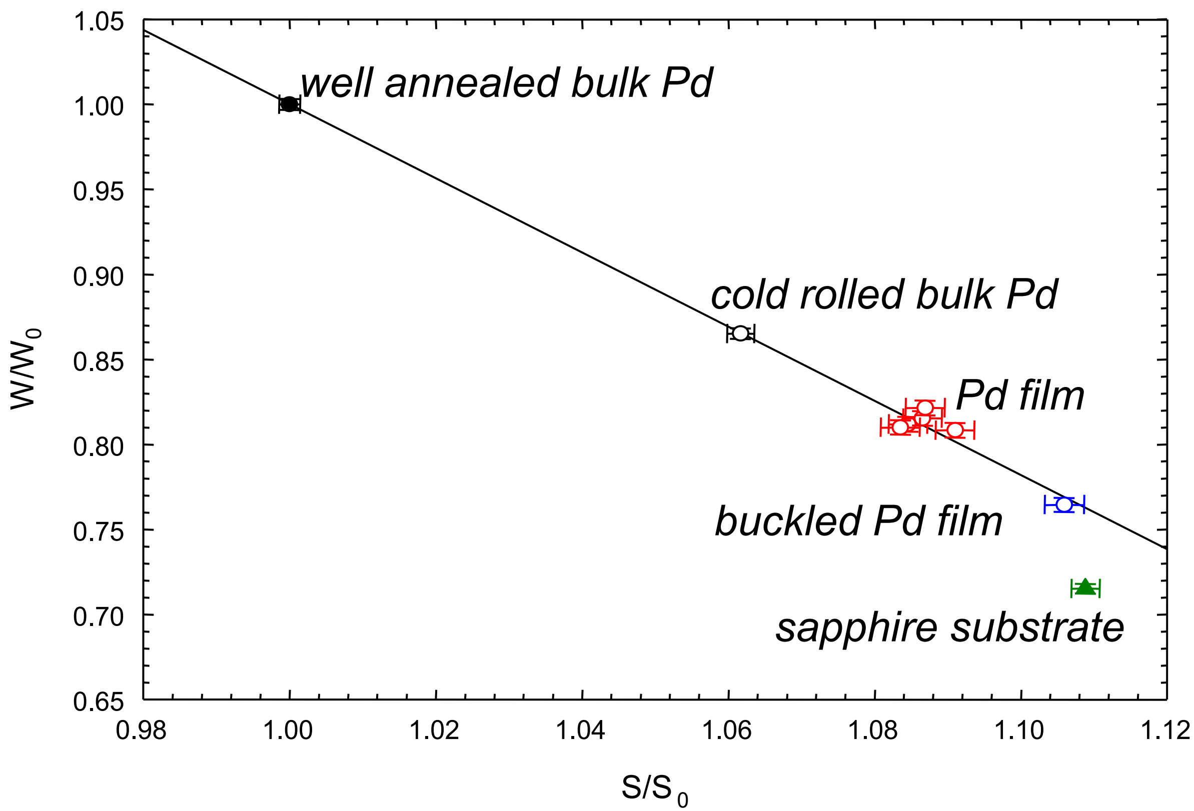
Pd film, thickness 1080 nm, step-by-step loaded with hydrogen

- S_{Pd} - parameter for the Pd layer
- $L_{+,Pd}$ – positron diffusion length for the Pd layer



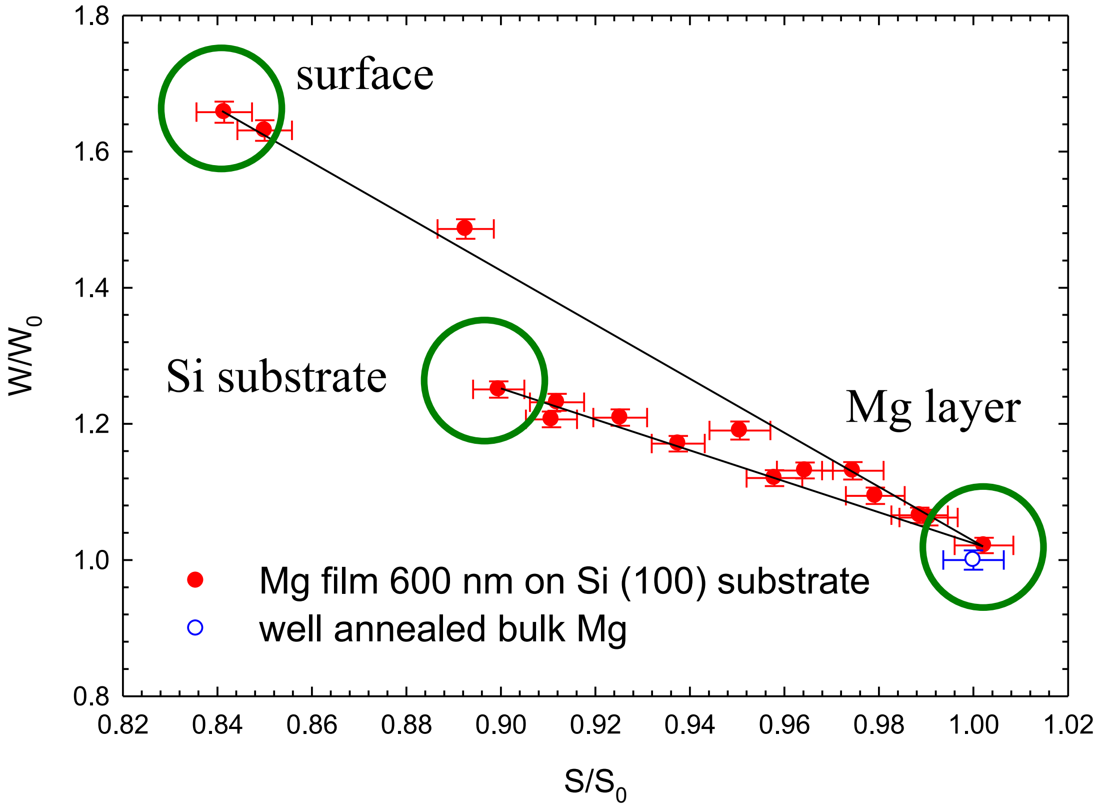
Hydrogen loaded Pd films

Pd film, thickness 1080 nm × **bulk Pd**



S-*W* plot

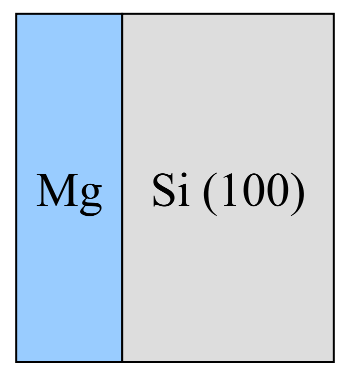
Mg film (600 nm) deposited on Si (100) substrate



- M – number of layers
- N_l – number of defects in l-th layer

$$\eta_{surf}(E)+\sum_{l=1}^{M}F_l(E)=1$$

$$\eta_{B,l}+\sum_{i=1}^{N_l}\eta_{D,i,l}=1$$



$$S(E)=\eta_{surf}(E)S_{surf}+\sum_{l=1}^{M}F_l(E)\left(\eta_{B,l}S_{B,l}+\sum_{i=1}^{N_l}\eta_{D,i,l}S_{D,i,l}\right)$$