




ISRAEL SUSTAINABLE ENERGY SOCIETY | האגודה הישראלית לאנרגיה מתחדשת

חדש תחת השמש




Novel multilayer solar absorber prepared by sputtering



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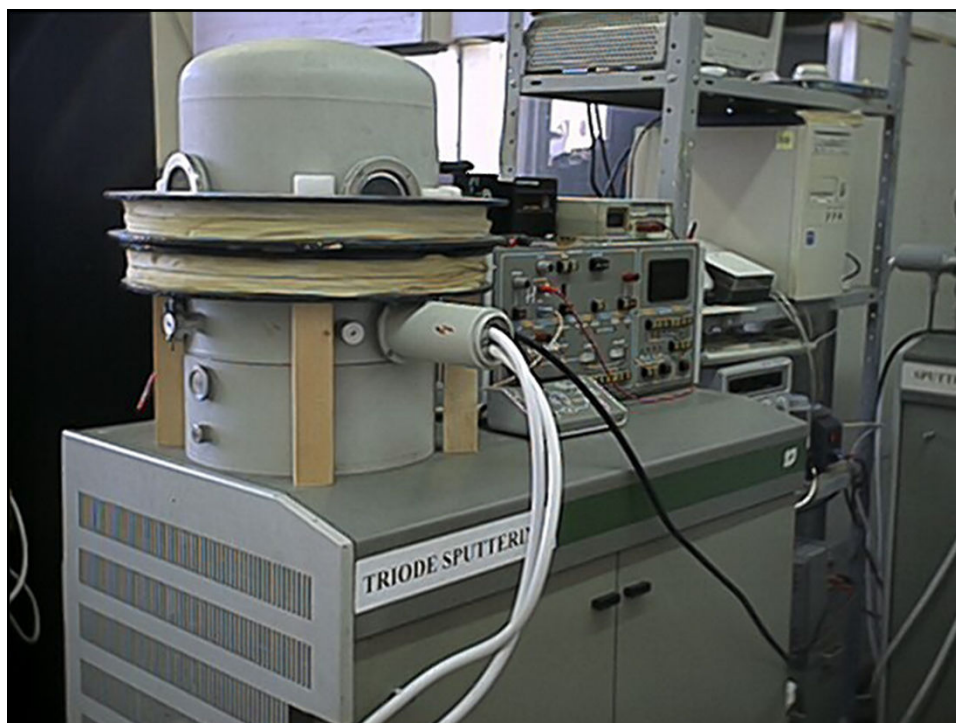
Background

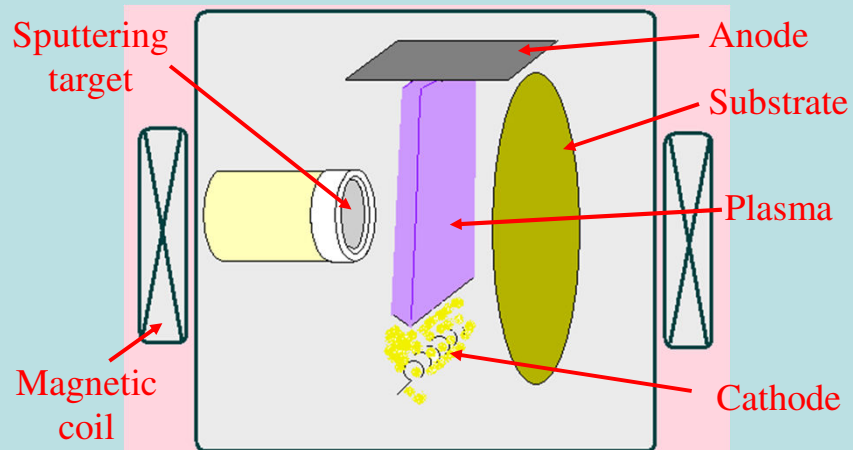
One way to increase the operating temperature of thermo-solar converters is to apply efficient selective coatings in the radiation collectors. These coatings must have low reflectance at wavelengths that are lower than $3 \mu\text{m}$ and high reflectance at higher wavelengths.

Objectives

In this work, we designed a Mo/Zn/Mo multilayer absorbing system, for solar selective applications. All of the films that make up this system were deposited by sputtering due to the high energy of the sputtered particles. Pressure of the sputtering gas plays an important role in the transport of sputtered materials to the substrate. The most pure and stoichiometric films may be obtained at low pressures only. Thus, the main goal of our work was to make high effective thermal absorbers using low pressure DC sputtering.



Sheet plasma sputtering method



Schematic diagram of the experiment.

A. Axelevitch et al., 7th IPS
Conference, Israel, 2004

Active Technological Parameters

P - Argon pressure: $(0.1-1) \cdot 10^{-3}$ Torr

T_S - Substrate temperature: $\leq 100^\circ\text{C}$

I_H - Electromagnet current: 4 A

I_C - Cathode current: 15.0–15.8 A

V_A - Plasma voltage drop: 30–35 V

I_A - Plasma current: 3 A

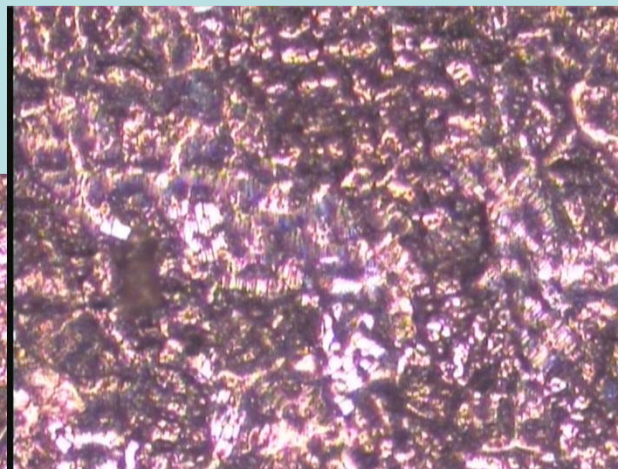
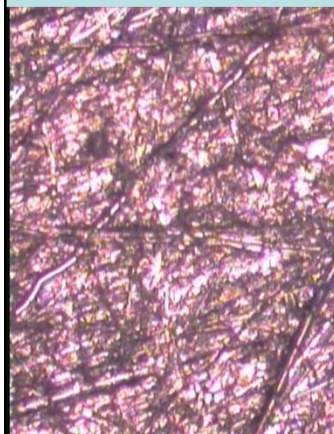
I_A - Discharge current: 0.5 - 4.5 A

V_T - Sputtering voltage: ~ 1.8 kV

I_T - Ions current: 18-28 mA

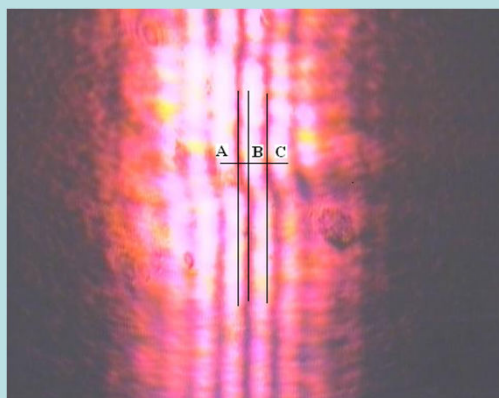
Zn sputtering target ($\times 160$)

A back side



A front side

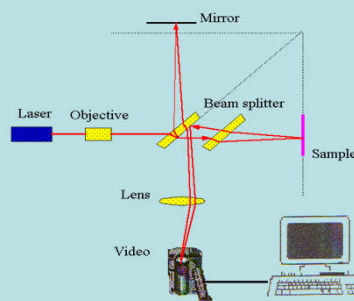
Interferential picture of Mo thin film deposited on Si substrate for a thickness evaluation



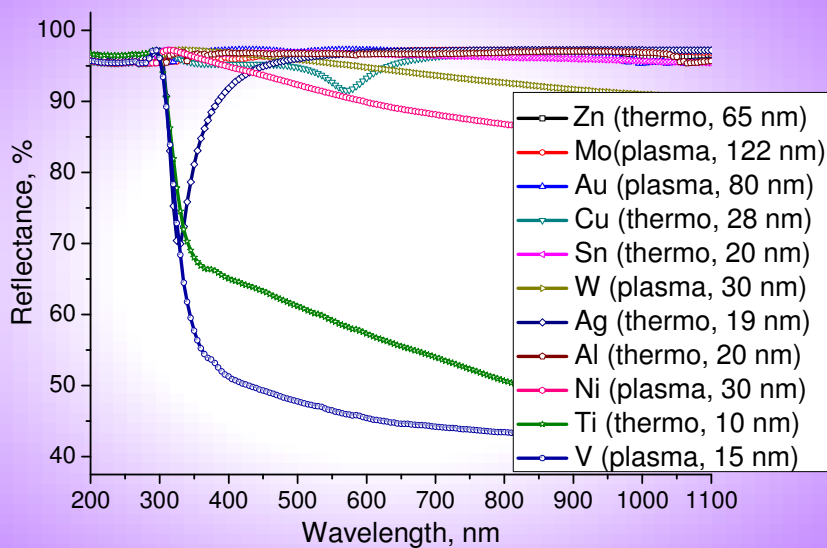
$$d = \lambda/2 \cdot (B - A)/(C - A)$$

$$d = 335 \cdot 12/33 \approx 122 \text{ nm}$$

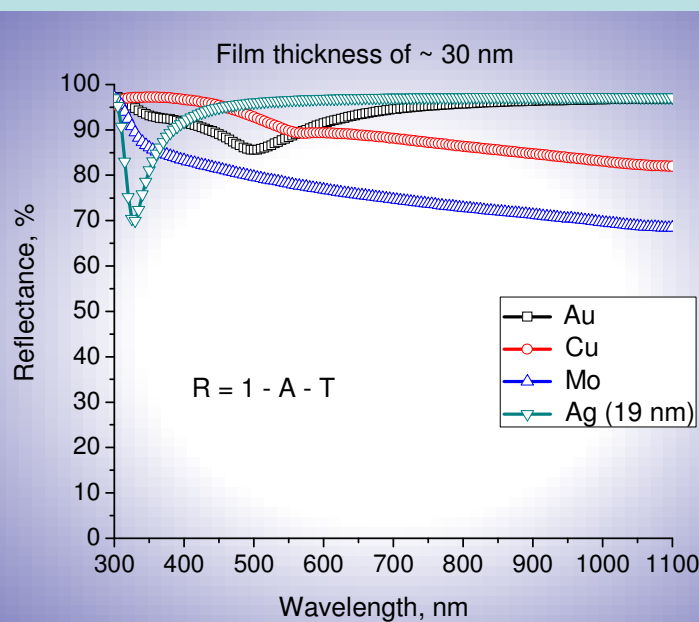
Thickness contact less measurement scheme

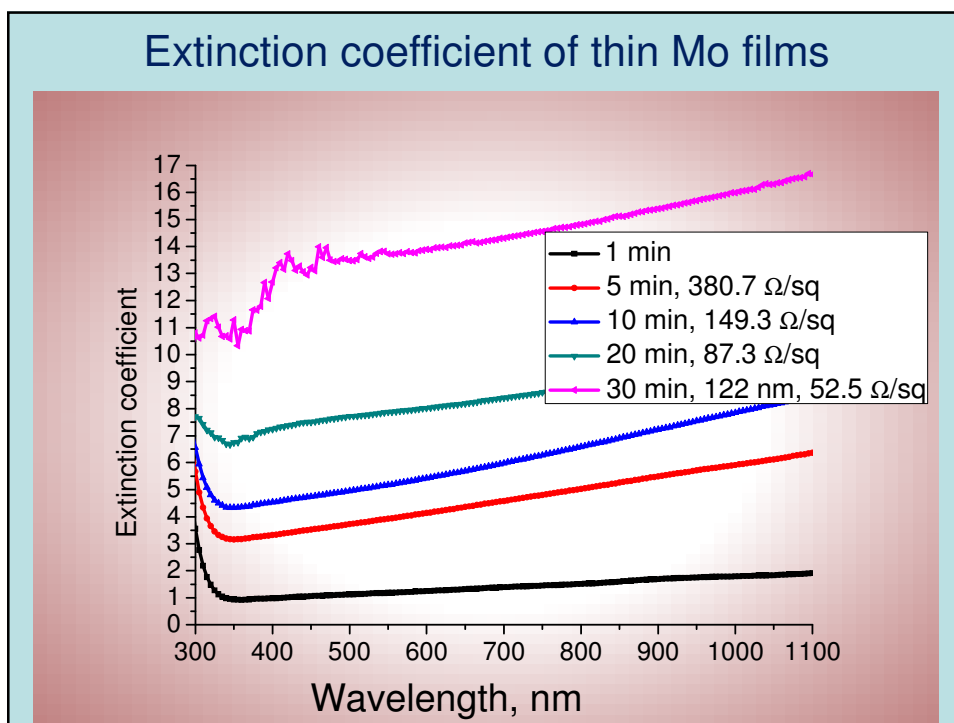
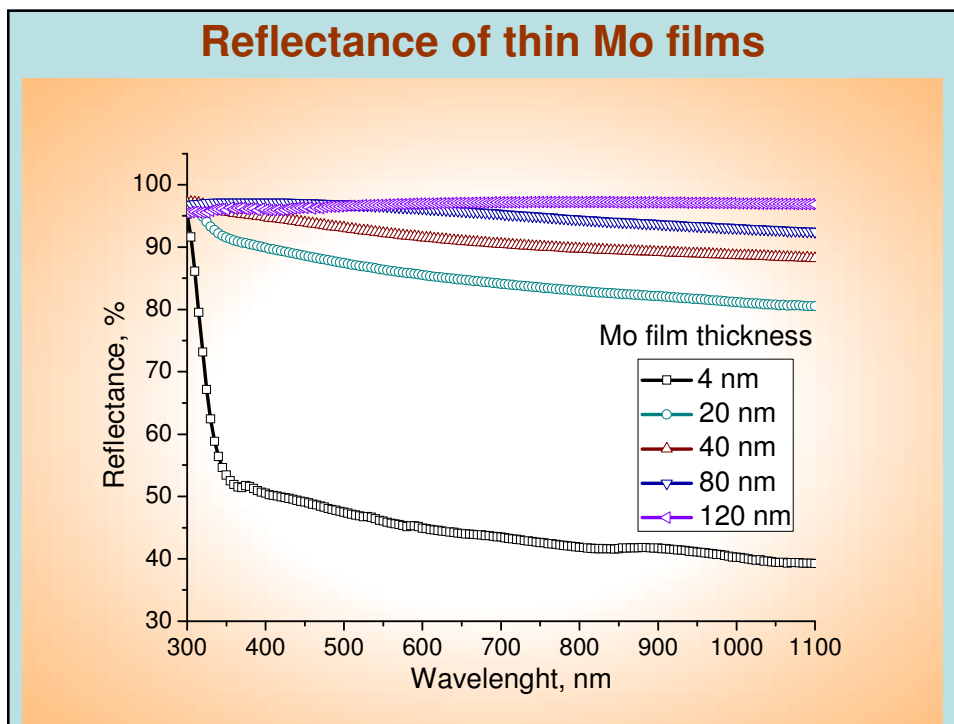


Thin metal films reflectance spectrum

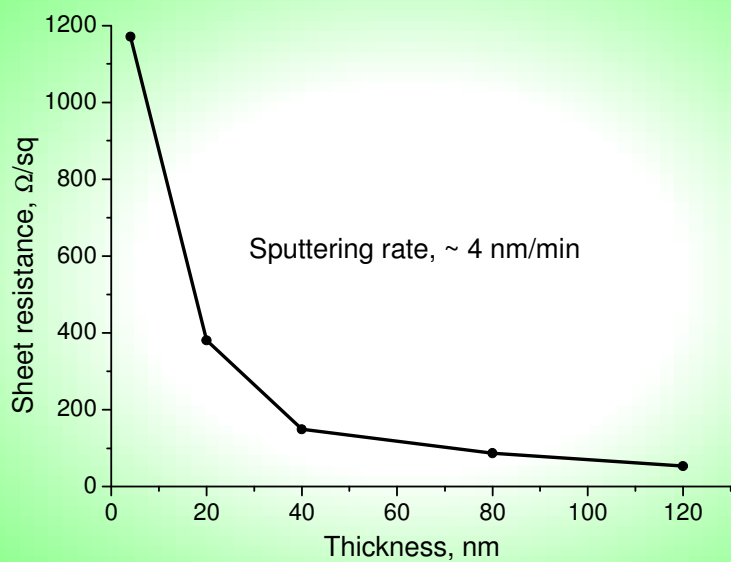


Various thin metal films comparison

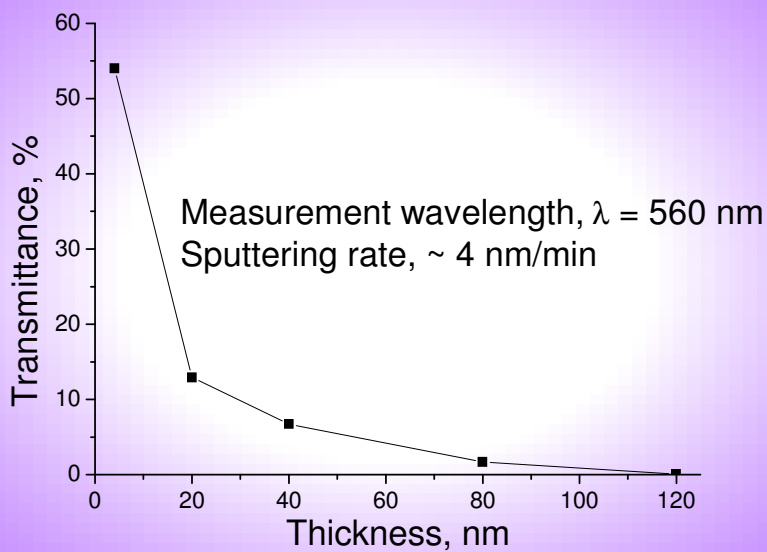


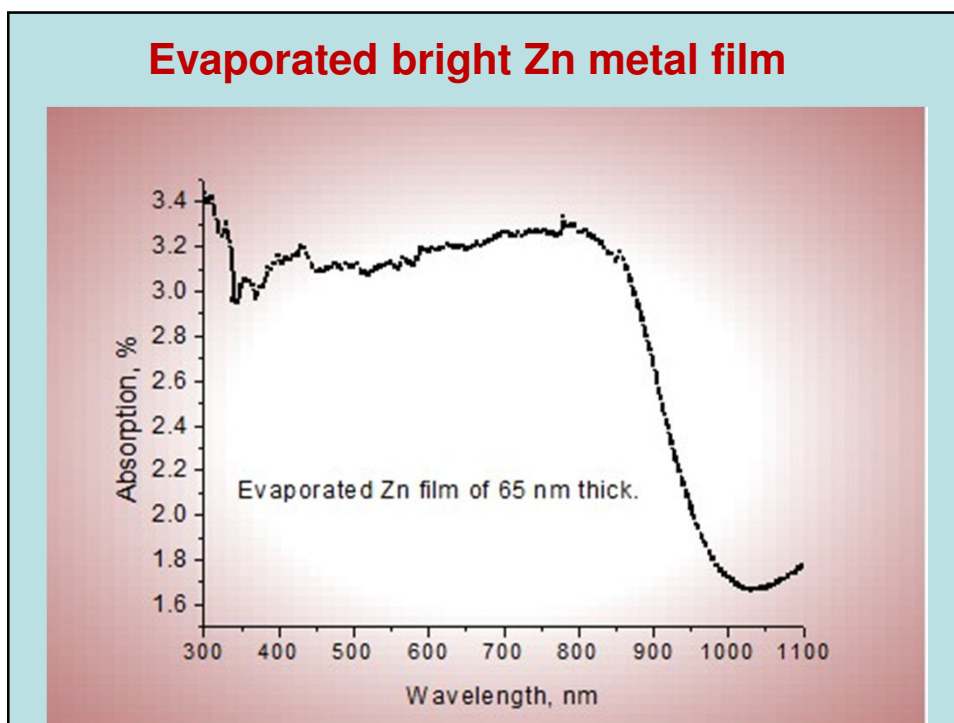
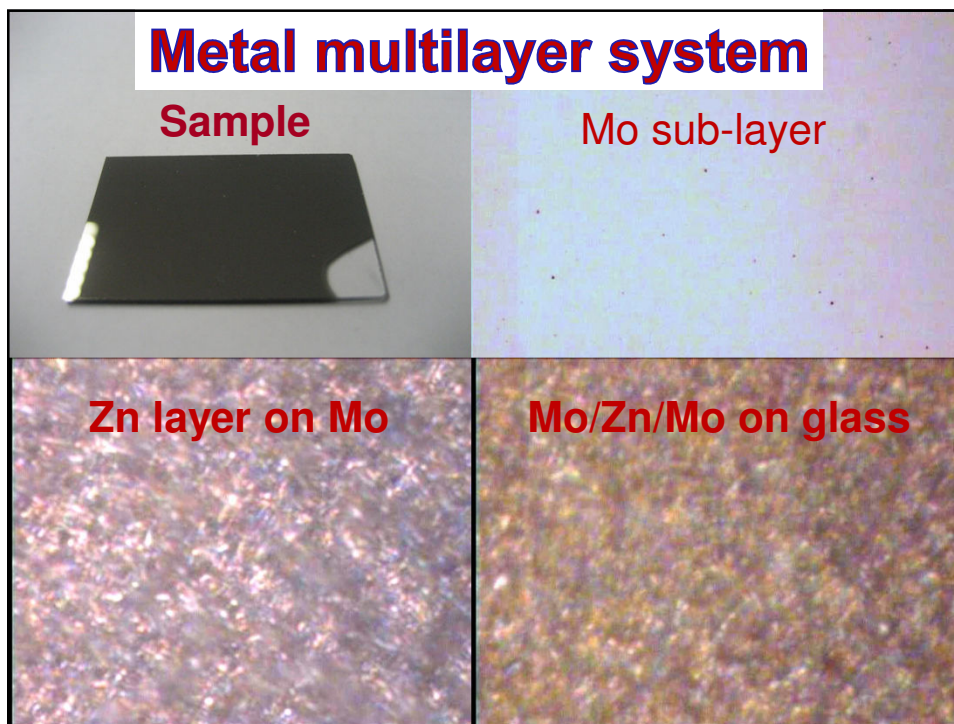


Electrical characteristic of thin Mo films

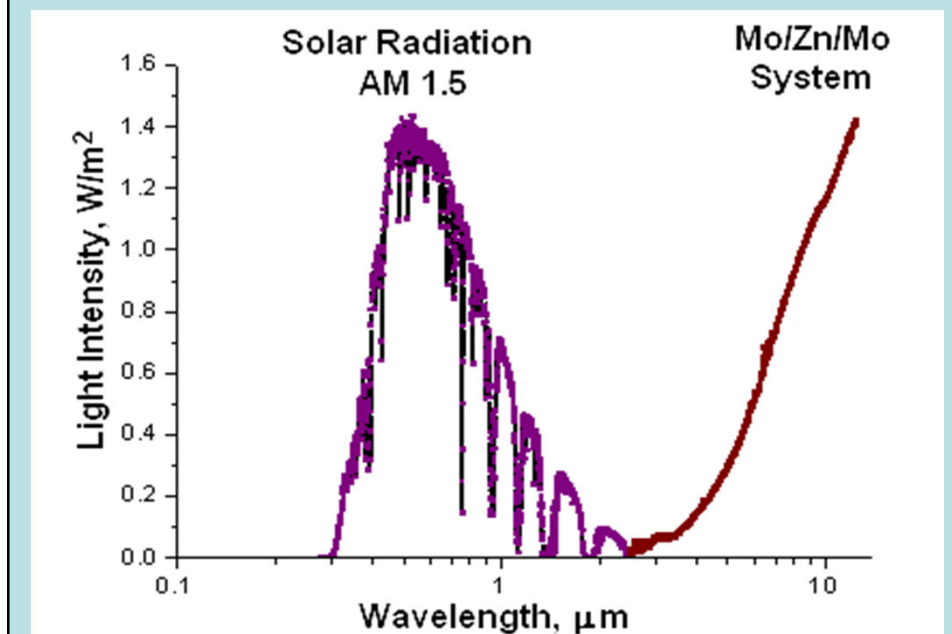


Optical characteristic of thin Mo films





Solar irradiation collecting system behavior




Conclusions



Feasibility proof of a multilayer thermal absorber consisting of: Mo-Zn-Mo thin layers was presented. Thickness of the layers was of ~120-150 nm, 1.5-2 μm, and ~5-10 nm, respectively. All layers were prepared by a novel sputtering method, providing a reliable and reproducible process at a low sputtering pressure of 0.1-1 mTorr with the high deposition rate. This method ensures a ballistic type of mass transfer from a metal target to the substrate. Method enables deposit pure metal films and to build solar absorbers from these films.

Thank you


**for your attention
and patience...**



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