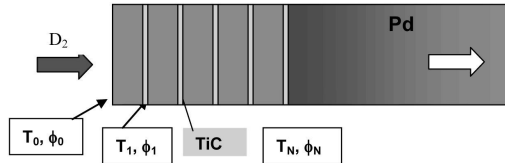


## WAVE NATURE OF DEUTERIUM FLUX PERMEATING THROUGH PALLADIUM THIN FILM WITH NANOMETER COATING LAYERS --- ( II ) THEORETICAL MODELING

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Super-wave has generated the long lasting, high gain “excess heat” in deuterium/palladium systems during Energetics Technologies, ENEA, and SRI collaboration. There must be an internal wave nature of the deuterium/palladium systems, which is in response to external super-wave, particularly, near the surface of the deuterium/palladium systems. Three sets of experimental data in the past 7 years at Tsinghua University are summarized to reveal this wave nature (please see abstract (I)). A simple theoretical model was set-up to understand this wave nature.



In the picture each interface is described by two parameters, the transmission rate ( $T$ ), and the change of the phase angle ( $\phi$ ). Based on the matrix algebra, we may reach 3 conclusions:

- (1) The transmission rate of the palladium coated with nanometer TiC-Pd layers is

$$T_N = \left| \frac{\sin \alpha_1}{\sqrt{\frac{1}{T_1} e^{i\phi_1} \sin(N\alpha_1) - \sin[(N-1)\alpha_1]}} \right|^2$$

$$\phi_N = \text{Arg}\left(\sqrt{\frac{1}{T_1} e^{i\phi_1} \sin(N\alpha_1) - \sin[(N-1)\alpha_1]} / \sin \alpha_1\right); \quad \alpha_1 = \text{ArcCos}\left[\sqrt{\frac{1}{T_1} \cos \phi_1}\right].$$

Here,  $N$  is the number of nanometer coating layers. Using 4 input parameters,  $T_0, \phi_0, T_1, \phi_1$ , it reproduces the experimental data. Here ( $T_0, \phi_0$ ) describes the interface between deuterium and palladium. ( $T_1, \phi_1$ ) describes the interface of Pd-TiC-Pd.

- (2) An identity is derived to show the correlation between deuterium flux and the “excess heat” :

$$\frac{A_{0N}}{T_{0N}} = \frac{A_0}{T_0} + \frac{A_N}{T_N} + \frac{A_0}{T_0} * \frac{A_N}{T_N}.$$

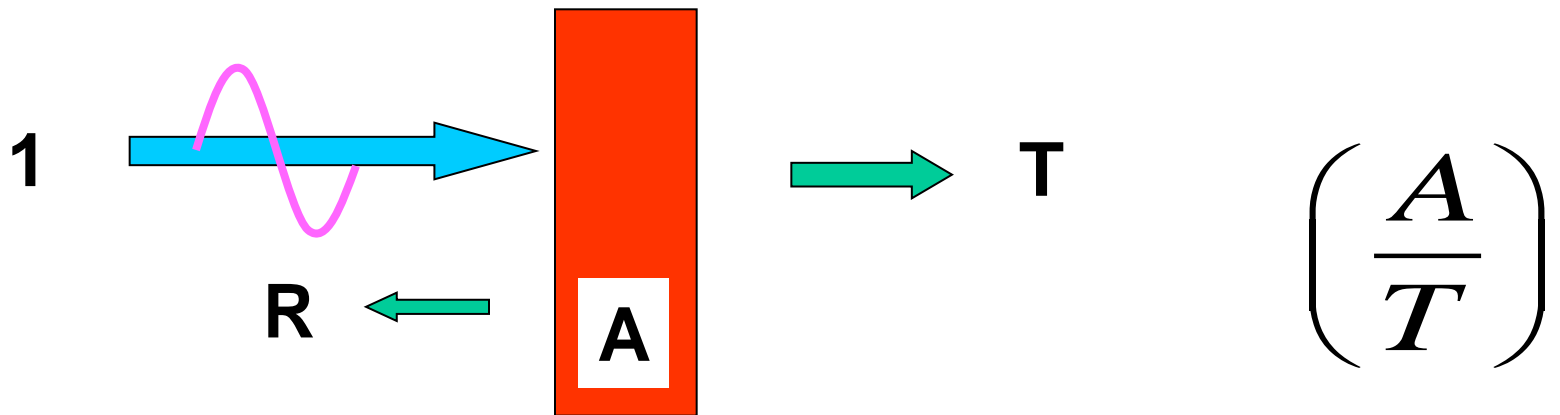
Here, ( $A_0$ ) describes the absorption in the interface between deuterium and palladium, and ( $A_N$ ) describes the absorption in the N-Layers of Pd-TiC-Pd coating. ( $A_{0N}$ ) describes the absorption in the combination of the interface between deuterium and palladium and the N-Layers of Pd-TiC-Pd coating. This identity shows the effect of multiple scattering among those interfaces.

- (3) Super-wave may affect the surface parameters  $\phi_0, \phi_1$ ; then, it changes the deuterium flux which permeating through the palladium film with multiple coating layers,  $T_{0N}$ . Thus it will enhance the “excess heat” ( $A_{0N}$ ).

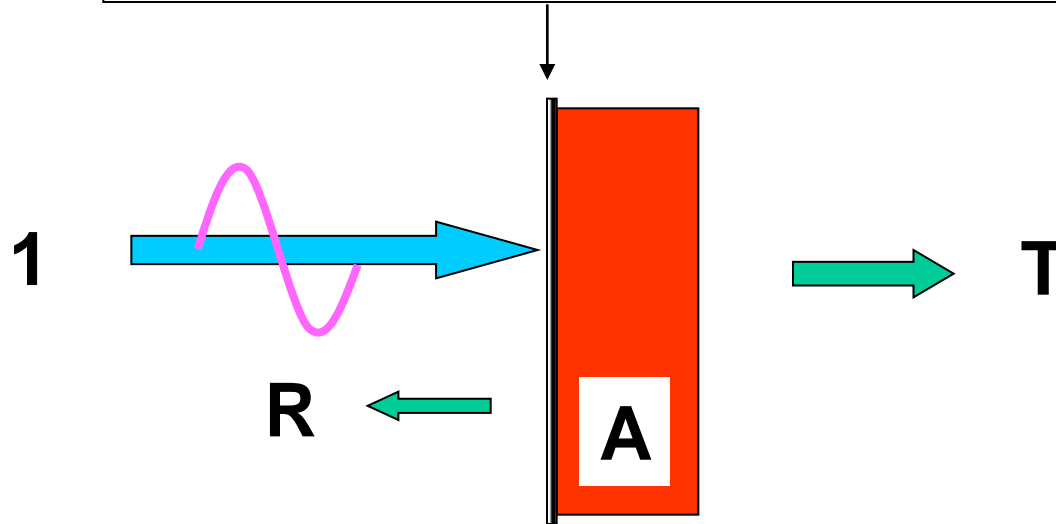
# Wave Nature of Deuterium Flux Permeating through Palladium Thin Film with Nanometer Coating Layers --- ( I I ) Theoretical Model ----

## Correlation (Flux & Heat)

$$1 - R = A + T$$



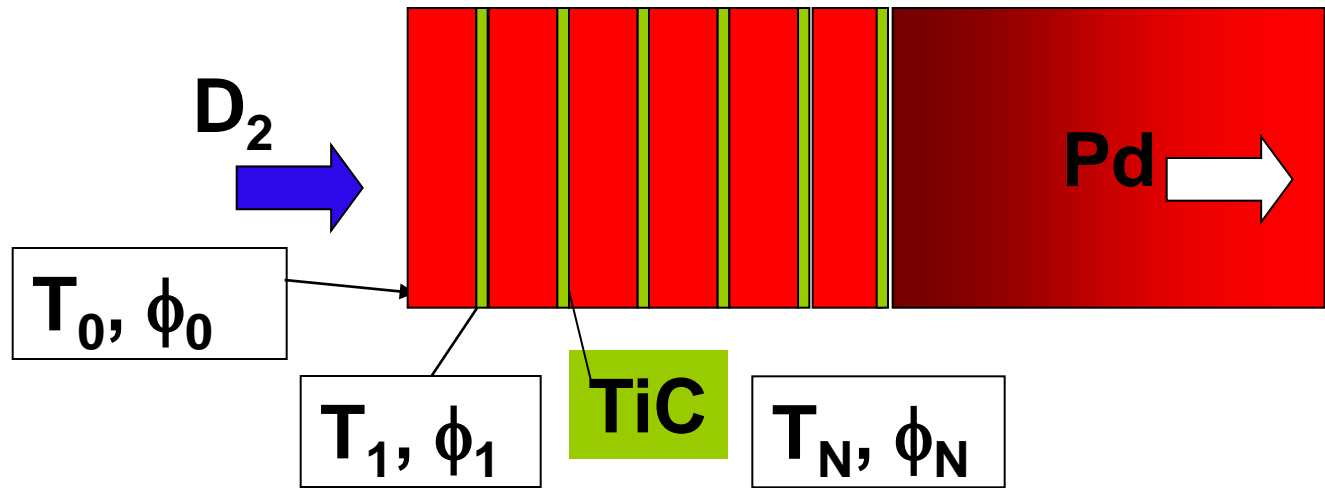
# Nano-Meter Coating Layers



## Wave Model Identity

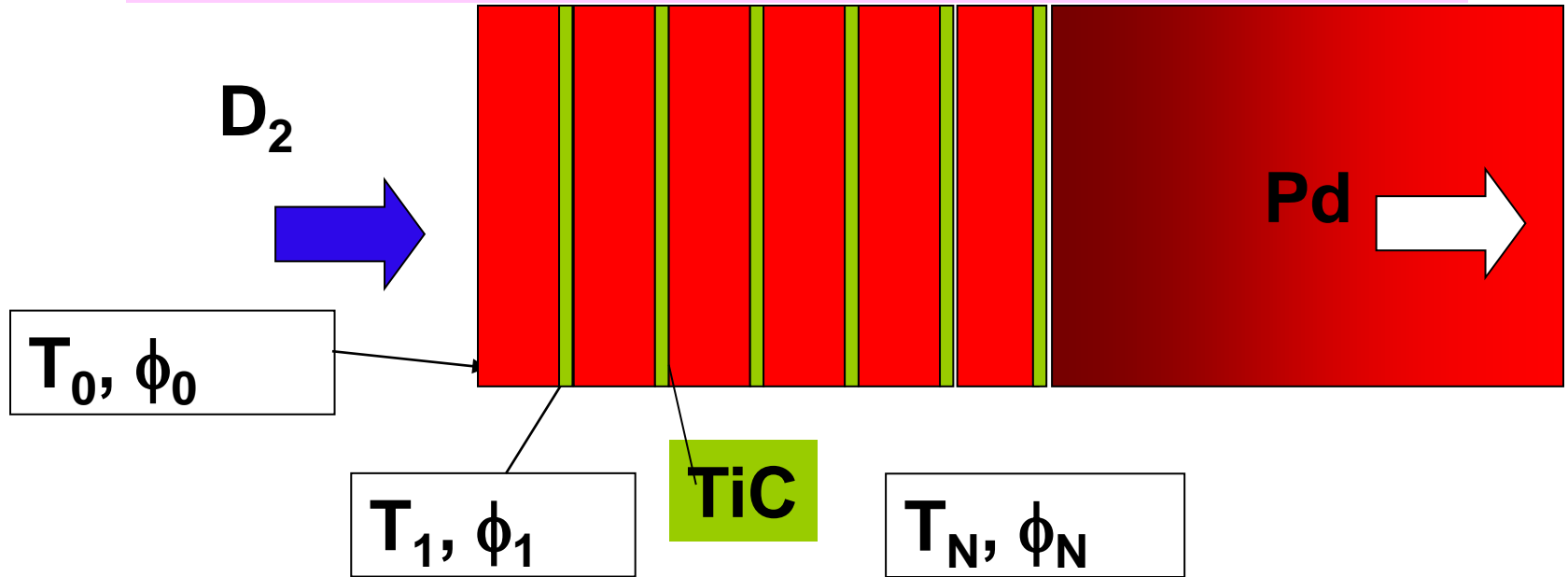
$$\frac{A_{0N}}{T_{0N}} = \frac{A_0}{T_0} + \frac{A_N}{T_N} + \frac{A_0}{T_0} * \frac{A_N}{T_N}$$

# Multiple Nano-Meter Coating Layer



$$T_{0N} = \frac{T_0 * T_N}{T_0 * T_N + (\sqrt{1-T_0} - \sqrt{1-T_N})^2 + 4\sqrt{(1-T_0)(1-T_N)}(\text{Cos}[\frac{\phi_0 + \phi_N}{2}])^2}$$

# High Deuterium Flux with High Loading



❖ High Flux with Coating Layer Build-up High Loading Surface (**Iwamura super lattice**)

❖ **Super Wave** may affect Phase  $\phi_0$  &  $\phi_1$  → High Flux ( $T_{0N}$ )

❖ High Flux ( $T_{0N}$ ) Introduces More Absorption ( $A_{0N}$ ) in Surface Layers (**Correlation** btn Flux & Heat)

