

## Material science from the view point of energy flowing

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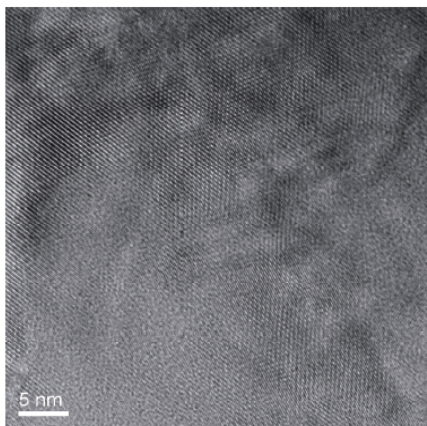
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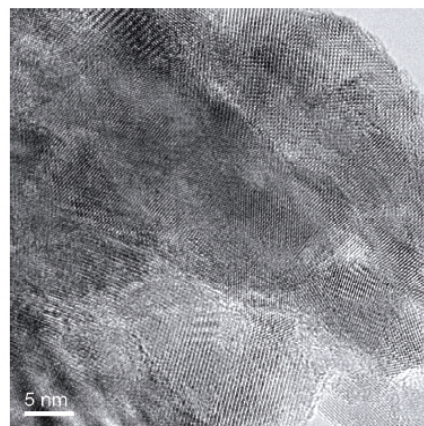
The microwave energy has been applied for plasma, especially to the ECRH. Recently, it has been cleared that microwave can also transmit into many materials, if it consisted of powders, such as very dense dust plasma. The powder metals are the typical examples. The microwave can transmit the energy into the molecule or crystalline of the materials almost at the speed of light and creates the non-thermal energy distributions in them.

The crystalline of the ferromagnetic powders deformed by the irradiation of high frequency magnetic field of microwave in a few seconds to continuous Nano-domains consisting of small magnets with 5~15 Nano meters. While the Nano-domains could not obtain by the microwave electric field, as it transferred kinetic energy through the collisions by plasma with higher energy electrons and ions. It is clear that the microwave magnetic field supplied the energy directly to the electron structures of the materials; especially it couples with electron spin motions. Such a direct energy pass from the electromagnetic field to the electrons is usual in the plasma physics, especially in RF heating, but it is not an idea familiar to the materialist.

Here, we would propose a new physical aspect combining with plasma and material sciences on the bases of energy flows that creates and governs the non-equilibrium reactions by electromagnetic wave energy. It has “microscopic scale” in the molecules or crystals and it proceeds reactions in the time shorter than the relaxation time to thermally equilibrium. Practically, it is Nano to large molecules or crystalline in the size and Femto ~ Pico seconds in time. It covers wide range of science and scientist including, plasma, fluid dynamics, materials, femto-lasers and bio-medicals.



Left: In electric field of microwave  
Keep the crystal structure



Right: In Magnetic field of microwave  
deformed to continuous Nano-domains