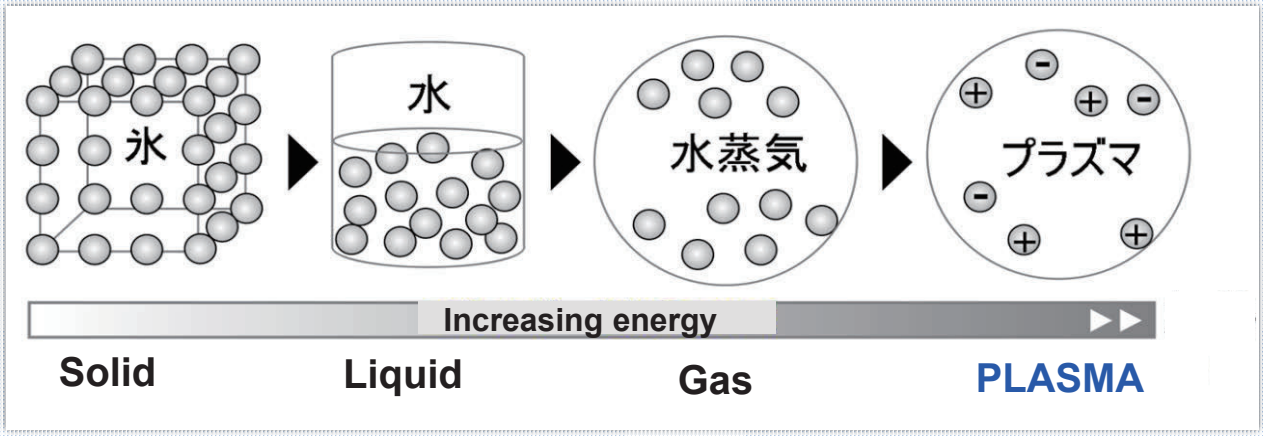
What is “PLASMA”?

The PLASMA is the fourth matter!



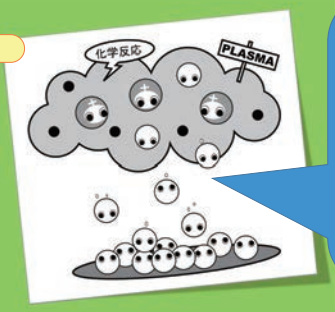
It is well-known that the matter changes with increasing energy, that is, solid (ice), liquid (water) and gas (water vapor). Furthermore the gas gets energy, the gas has negative and positive charged particles, it is so-called the fourth matter “PLASMA”. The difference between the gas and the plasma is that the plasma is shining. In the nature world, there are thunder, aurora and sun. We can also see a fluorescent lamp and a flame.

What can “PLASMA” do ?

The Plasma is like a “Magician”!

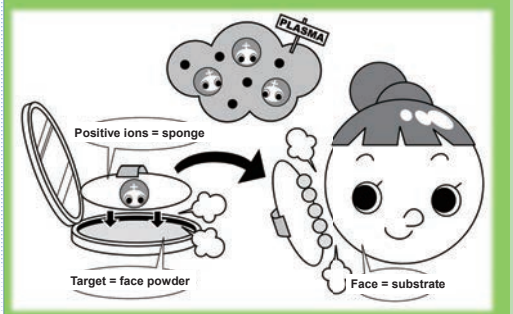
Plasma produces diamond using liquor including hydrocarbon!

Plasma CVD



In plasma, electrons collide with hydrocarbon gas so that hydrogen and carbon are produced. Then, carbon atoms are deposited on the substrate.

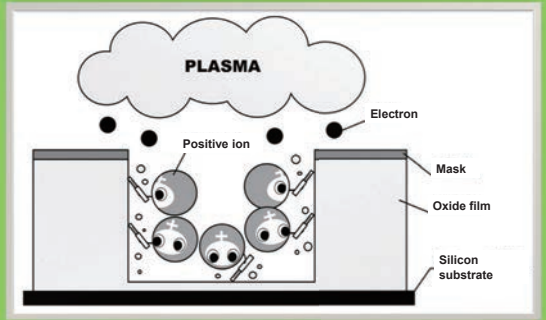
Sputtering



Positive ions impact a target so that atoms in the target are thrown up in the plasma. They are deposited on the substrate. This phenomena is so-called “sputtering”.

Dry etching

Positive ions in the plasma collide the masked substrate and then submicron size trench can are formed.



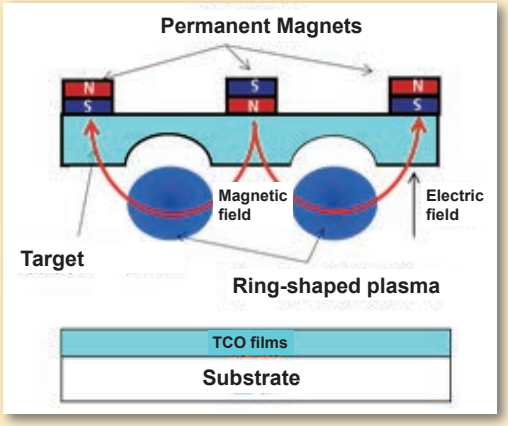
Preparation of transparent conductive oxide films by plasma sputtering

How are TCO films used?

Transparent conductive oxide **(TCO)** films are widely utilized for various informative products such as smartphone, tableted computer, solar panel and liquid crystal display. The indium tin oxide (ITO) films with resistivity of $10^{-4}\Omega$cm are frequently used. Nowadays, Al-doped ZnO (AZO) films are studying because the indium is rare metal.

How to prepare TCO films?

Magnetron Sputtering Deposition



Problems

(1) Low target utilization rate 20-30%

↓

Waste of resources

(2) Non-uniform profile of resistivity under substrate non-heating

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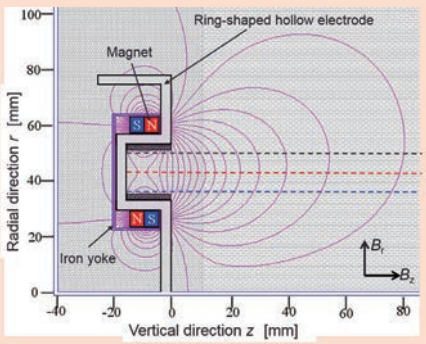
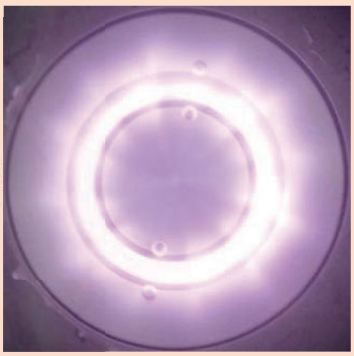
It is difficult to deposit TCO films on low melting point plates like plastic plate.

Properties of TCO films deposited by novel sputtering apparatus

Preparation of AZO films by novel sputtering apparatus



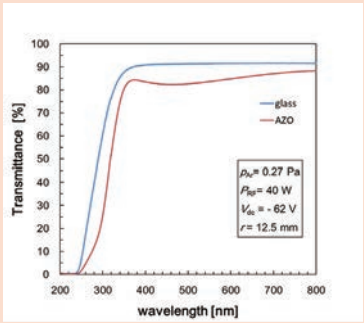


The following results are attained by our apparatus.

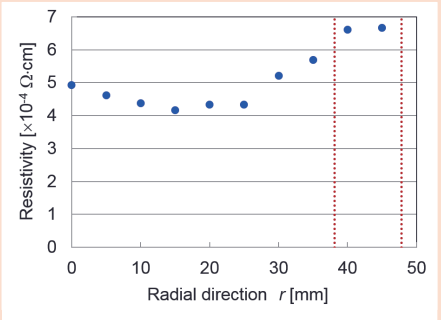
(1) Uniform target utilization

(2) Uniform profile of resistivity of AZO films under non-heating

Transparency 80%



Resistivity $10^{-4}\Omega$cm



c-axis orientation