

**THE FIRST OF ITS KIND IN THE WORLD:
NEW TECHNOLOGY SPEAKER DIAPHRAGM MATERIAL MADE FROM ULTRA-THIN PURE
MAGNESIUM FOIL**

Foster Electric Company, Limited of Tokyo Japan has succeeded in developing an ultra-thin diaphragm material for loudspeakers made from **'pure' magnesium foil** as a world first. This new process involves coil material as thin as 30-microns, which is rolled out by continuous warm rolling with the cooperation of MITSUBISHI STEEL MFG. CO., LTD.

This new loudspeaker technology using a **'pure' magnesium diaphragm** enables greatly improved high quality sound reproduction that has less distortion, less peak resonance and less echo (which is normally inherent in metals), over a much wider range. This is thanks to the nature of its lighter weight and increased internal loss, which exceeds times two when compared to the more conventional magnesium-alloy materials. FOSTER ELECTRIC plans to start mass-production of speakers using this new type of diaphragm material by the fall of 2004.

Until now, many kinds of materials such as paper, metals, numerous plastics and etc have been used as a speaker diaphragm. When it comes to metals, lightweight alloys such as aluminum-alloys and titanium-alloys etc have been used mainly for tweeters thanks to their high rigidity as well as their ability of conveying the sound at high speed. However on the other hand, they do have some shortcomings with regards to peak resonance, and in the echoes that are inherent in metals due to their low internal loss and damping factor.

Magnesium, which is much lighter in weight, stronger, more rigid, and has higher internal loss than aluminum or titanium, has always been one of the most difficult materials for processing, and therefore not until recently were developments made to utilize magnesium-alloys for loudspeakers. However, here we are talking about **99.9% 'pure' Magnesium**, a material even more difficult for processing than conventional magnesium-alloys, which means that FOSTER ELECTRIC has worked to overcome these technological problems for the first time in the world.

Corrosion problem solved: FOSTER ELECTRIC has been aiming at using **99.9% 'pure' magnesium** which has the lightest weight and the highest internal damping loss among the magnesium group, making it an ideal material for loudspeaker diaphragm applications. In business cooperation with MITSUBISHI STEEL, Foster Electric has for the first time succeeded in forming **99.9% 'pure' magnesium foil** into loudspeaker tweeter diaphragms. This utilizes a new technology that increases the deep-drawing ability during the press-forming process by using the lubricating effect obtained from a special plastic ultra-thin film coated on the surface of the magnesium foil before processing. This has succeeded due to being used together with other new

technologies such as MITSUBISHI's special continuous warm rolling process technology, their accumulated mold design technology, and warm deep-drawing process technology. This special plastic ultra-thin film coating, which is patent pending by MITSUBISHI STEEL MFG. CO., LTD, also gives the rustproofing function that solves the corrosion problem inherent in magnesium, and does so without spoiling the sound quality.

Sound Property Comparisons of Light Metal Materials:

		99.9% 'pure' Mg	Mg-Alloys	Al-Alloys	Titanium
Specific Gravity	g/cm3	1.74	1.77	2.74	4.50
Young's Modulus	Gpa	40	41	65	110
Speed of Sound	m/s	4760	4880	4880	4940
Bending Strength		2.76	2.72	1.78	1.10
Vibration decline /damping factor		0.0100	0.0044	0.0025	0.0020

The first loudspeaker diaphragm developed using this new technology is a dome type tweeter of 25mm diameter, which uses **99.9% 'pure' magnesium** foil of 0,05mm thick. When compared to magnesium-alloy AZ31, it has higher rigidity and yet superior vibration decline and internal damping loss that exceeds twice of that of AZ31, without spoiling the speed of sound traveling through the diaphragm. Furthermore, when compared to conventional aluminum-alloys or titanium-alloys, it has 4 to 5 times of the vibration decline and damping capability.

Making the most of the characteristics of the material, FOSTER ELECTRIC have utilized non-axial symmetry for its shape in order to disperse the peaks in high frequency vibration range. As the result, this has flattened the frequency characteristic and lowered the distortion, which is successful in improving the sound quality.

FOSTER ELECTRIC will expand its applications towards the super tweeters and high-end Hi-fi systems for SACD and DVD Audio, where the reproduction of highest fidelity sound is required.
