

# Material Technologies Applied to NEC Tokin's Electronic Device Technologies

This Special Issue features product development technologies of NEC Tokin Corporation, a core company in the electronic device business of NEC Group set to become a “Material-Based Device Creation Company.” NEC Tokin proposes optimum solutions for customers by implementing proprietary key devices for innovation ahead of the rest of the world employing core material technologies.

This Special Issue shows technological trends, device technologies, and products developed in three areas where material technology is applied: energy devices including Proadlizers, NeoCapacitors, and lithium-ion rechargeable batteries, magnetic devices such as choke coils and noise suppression sheets, and applied piezoelectric devices. Making use of the products above, NEC Tokin offers solutions for a wide range of markets ranging from IT including mobile phones and digital home appliances to environmental, medical, and welfare solutions.

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## 1 NEC Tokin's Core Technologies and Basic Product Development Strategy

Emphasized markets for NEC Tokin's business include a wide variety of areas such as the IT market represented by mobile and digital equipment, automotive electronics and communication infrastructure, as well as environmental, medical, and welfare.

For the markets above, our activities try to meet market needs and solve our customers' issues (see **Fig.**) by proposing three classes of device solutions as described below:

- 1) “Energy solutions” aimed at solving energy-related issues for applications ranging from mobile equipment to large-capacity energy storage.
- 2) “Noise & Power solutions” focusing on the accruing noise problem and the search for miniaturization and high efficiency.
- 3) “Access solutions” to meet diversified information and communication needs for data, voice, image, and the like.

The origin of our competitiveness is of developing state-of-the-art proprietary products in which material technologies play a fundamental role.

Our material technologies include functional materials such as fine tantalum powder, conducting polymers, and battery ac-

tive materials, ferrite and magnetic metals, as well as ceramics such as dielectric and piezoelectric materials.

We not only count with our technological know-how accumulated throughout the years regarding material development but also promote research and development activities through proactive cooperation with universities and research institutes that are well-established in that area.

## 2 Device Solution Strategies at NEC Tokin

We will now explain the three device solution strategies proposed by our company and the key innovative devices that embody them.

### 2.1 Energy Solutions

Power sources for mobile equipment such as personal computers and phones are required to realize functions that depend on their applications which may range from supplying large amounts of instantaneous current to absorb fluctuations of CPU load or supplying relatively small currents for a long time. Our strength is that we have a lineup of advanced devices such as Proadlizers and tantalum capacitors (short-distance runners)

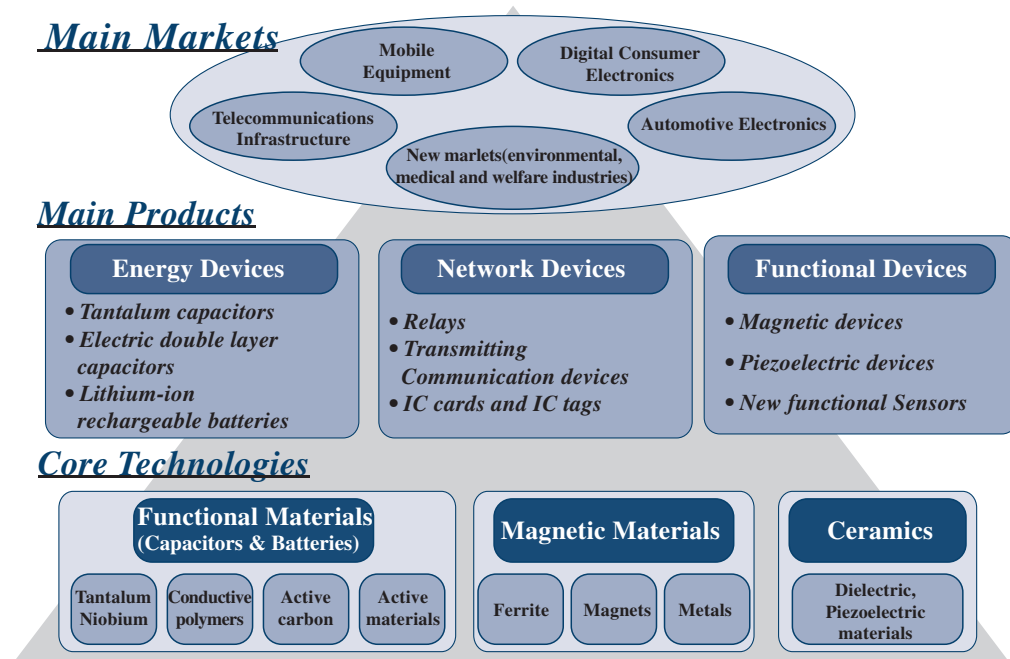


Fig. NEC TOKIN's business fields.

that supply large amounts of instantaneous current, lithium-ion rechargeable batteries (long-distance runners) which are devices suitable for long-term power supply, as well as double layer electric capacitors (medium-distance runners) whose performance fills the gap between the former two.

Moreover, it is worth noting that by combining the energy devices above we offer proprietary energy solutions that result in miniaturized power source systems, power saving, and low cost.

Prodlizers are revolutionary devices that can deal with CPU load fluctuations in an arena where CPU's are recently characterized by increasingly large currents. Due to their broad bandwidth, low impedance, and large capacity, a single unit can replace dozens of multilayer ceramics and aluminum electrolytic capacitors.

NeoCapacitors have an oxide coating formed by anodization of the surface of a fine tantalum sintered structure. These capacitors can deal with ultra-high frequencies and are the first in the world to form a conductive polymer coating on the cathode layer.

Lithium-ion rechargeable batteries are required to meet increasingly stringent requirements of compactness and lightness to equip personal computers, mobile phones or the like, and find a large variety of practical applications. Customer needs related to product safety have recently increased due to higher densities of stored energy. We were the first in the world to develop a practical rechargeable manganese lithium ion battery, which is

attracting considerable attention due to its resistance to over-charge, heat stability and safety. We also have a lineup of large-capacity products where the electrodes have been transformed into a laminated structure with an external aluminum-based laminated film that resulted in light weight. It is expected that the market for these products will expand especially in such areas as electrically-assisted bicycles, electric tools, UPS (uninterruptible power supply) or other applications that require large power.

## 2.2 Noise & Power Solutions

Due to the increasing complexity of mobile equipment, noise suppression measures have to cope with a wide frequency range that covers orders of kHz to GHz. It is also worth noting that the trend of using lower CPU driving voltages also require measures related to lower noise acceptability.

In addition, the increasing density of components integrated in electronic equipment creates the need for compactness, small loss, and large current capacity by transformers and coils used in inverters, switching power sources, DC-DC converters and the like. The "Noise & Power Solutions" are concerned with the search for small size and high efficiency to deal with the noise problem, which is becoming more and more critical as explained above. Our company offers the three product categories shown below.

- 1) Capacitors and inductors used as devices against

conductive noise, which starts to become a problem at relatively low frequencies of noise.

2) Magnetic sheets (product name: "Flex Suppressor") featuring the highest magnetic permeability in the industry to be used against radiant noise, which constitutes a problem at high frequencies (order of Gigahertz).

3) Magnetic sheets for RFID to be used against signal quality deterioration near metal parts, a problem that occurs in communications (wireless tags, etc.)

In addition to offering a powerful lineup of products against noise, we also propose optimized solutions based on the analysis of the customer's noise environment.

Reducing the size and improving the efficiency of choke coils and transformers used in electric circuits result mainly from the characteristics of their core materials. Since its establishment, the company has been involved in the practical use of advanced core materials such as ferrite through cooperation with local universities and has succeeded in implementing materials based on amorphous magnetic metals suitable for applications that require small loss and large current.

In addition to existing ferrite materials, we are contributing to miniaturizing and the extending operation time of mobile equipment such as laptop computers by offering products that employ core materials made of amorphous magnetic metals.

### 2.3 Access Solutions

"Access Solutions" address several problems related to communication of digital information such as data, voice, or video which result from the popularization of IT technologies and the increasing complexity of communication technologies.

Compact and highly efficient devices are required to support information and communication technologies in wired applications such as xDSL or wireless applications such as RFID or IC tags, and the connectivity of such devices to the IT network through modularization and construction of systems is a vital issue.

In the area of mobile phones used as information terminals for the IT network where the trend towards higher complexity is expected to continue, example applications of piezoelectric technologies for reading digital information such as voice and video are starting to appear. Our company is the first in the world to put into operation a multilayer piezoelectric actuator. Thanks to its high displacement precision, this device is gradually finding applications in the household electric appliance scenario, appearing in anti-shake functions of digital cameras and mobile phones. Unlike electromagnetic devices, the piezoelectric actuator does not require a driving coil and thus is effective for mobile phones and equipment where compactness and energy saving are desirable features. The demand for these appli-

cations is expected to grow even faster from now on.

In addition, using the piezoelectric actuator connected to a vibrating acoustic equipment results in practical acoustic devices capable of transmitting the vibration directly to a person's auditory system. Using this technology, we have implemented and mass-produced a bone conductive receiver/microphone for mobile phone applications. This product finds applications not only for the aged or people with hearing impairment but also as a tool that enables smooth conversation through mobile phones in noisy environments, with promising applications and markets.

### 3 Future Projects

We expect to continue providing new innovative key devices through combination and modularization using material and device technologies, taking the three device solutions above to even higher levels of excellence towards our ultimate goal of creating a "ubiquitous society."