The 44th Tokyo Motor Show

Noteworthy Cars Advance New Technologies

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Held at the Tokyo Big Sight, the 44th Tokyo Motor Show opened to the public on October 29th and closed on November 8th, 2015. According to the organizer, the Japan Automobile Manufacturers Association, a total of 160 firms from 11 countries participated. Under the theme, "Your heart will race," automakers showcased 417 cars, including 75 making their world premieres (68 of which were from domestic Japanese automakers). Cars equipped with cutting-edge technologies, such as fuel cell vehicles (FCVs) and driverless cars, attracted a lot of attention.

Attention Grabbing Cars

Mazda Motor Corp. displayed two noteworthy cars, the Roadster and the RX-Vision concept car. Both models implement SKYACTIVE Technology, which pursues the ideal structure for the different parts, such as body, chassis, and engine, to optimize distribution of functions and achieve improved fuel economy, emissions, performance, and reliability. The Mazda Roadster performance requirements meant that it needed to be light and compact (Figure 1). In order to maintain these basic necessary conditions, the company addressed the issue of weight reduction with an overall new design. Using the SKYACTIVE Technology, Mazda introduced compact parts, reformed the structure, and increased the use of aluminum and other lightweight materials. Applying these measures and utilizing aluminum in the hood, front fender, rear side, and trunk materialized a large weight reduction of more than 100 kg (which differs depending on the model), compared to the previous Roadster.

Figure 1. Mazda Roadster.

Mazda's RX-Vision concept car drew particularly high attention at the show, as it inherits the traditional rotary sports car engine after the production of the RX-8 ceased. (The RX-8 also utilized an aluminum double-wishbone front suspension.) Mazda is said to be the only carmaker in the world to successfully bring to market and mass produce a rotary engine. The SKYACTIV-R rotary engine enabled the designers to implement a low and wide sports car body on the RX-Vision.

The Honda NSX concept car featured a mid-ship direct-injected VTEC V6 engine (Figure 2). The model is designed to be both eco-friendly and sporty with a highly efficient and high output Sport Hybrid SH-AWD system installed. The prior NSX (whose production ended in 2005) used an all aluminum monocoque body, but the latest NSX model uses a mutli-material design with a composite body combined together with aluminum, ultra-high strength steel, and other advanced materials, which are joined using an innovative technology. As a result, the unitized space frame design of the NSX has enhanced its torsional and bending performance considerably. Honda has also implemented a new casting technology, which enables the joining of strong forged materials with flexible ones. This technology was used to combine a body panel composed of aluminum and ultra-high strength steel with a carbon fiber floor in a highly precise manner in order to achieve significant weight reduction.

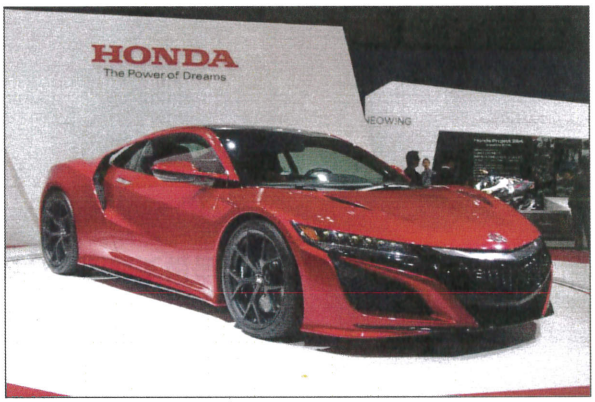

Figure 2. Honda NSX concept car.

Toyota Motor Corp. premiered its new 2016 Prius in Las Vegas, NV, followed by the first presentation of the model in Japan at the Tokyo Motor Show. The Prius was first introduced in 1997 as the first mass-produced hybrid passenger car in the world. For the development of the fourth-generation model of the Prius, the company applied a newly developed platform called Toyota New Global Architecture (TNGA), a company wide program to approach the reformation of manufacturing car structures. Through TNGA, Toyota has renewed power train components and vehicle platforms and is implementing a new integrated development program with the objective of dramatically improving basic performance and product appeal. The program was used on the Prius to make the silhouette of the car more stylish by lowering the top of the roof by 20 mm and moving it forward (Figure 3). More extensive use of aluminum components, including the hood and rear doorframes, keeps vehicle weight in check and also helps to reduce the center of gravity. Furthermore, innovative fastening methods such as laser screw welding and advanced body adhesives help create a rigid structure. As a result, handling stability and riding comfort have improved. The engine mount-

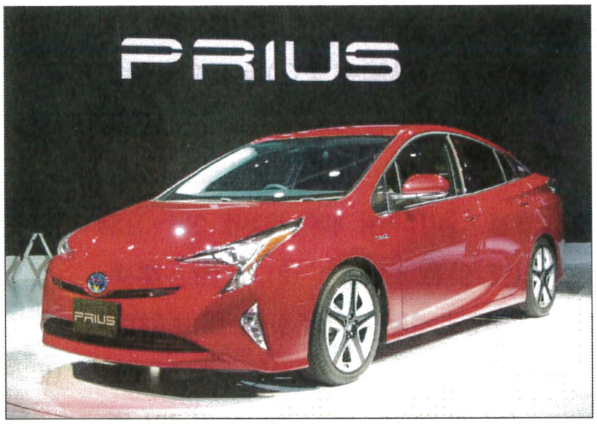

Figure 3. Toyota Prius.

ed on the Prius has a maximum thermal efficiency of 40%. This, combined with a program of size and weight reduction of the overall components, including the motors, transaxle, and power control unit, resulted in a fuel economy of around 40 km/l at JC08 cycle, depending on the grade of Prius.

Nissan Motor Co. exhibited models at the show that emphasized the company's efforts in introducing state-of-the-art technologies for the automotive industry, such as the Nissan Leaf, which pioneered electric vehicle (EV) technology for the mass market. The Leaf is one of the top selling EVs around the world, having sold over 180,000 units since its launch in 2011. It is a steel bodied vehicle with aluminum doors. The new Leaf model has undergone minor changes, providing a significant improvement in driving range on a single charge and exhibiting a new grade, which extends this to 280 km when the battery is fully charged. To improve safety performance, forward emergency braking has been installed on all models as a standard system.

Nissan took the zero emission concept of an EV and combined it with autonomous driving technology to make the IDS concept vehicle. Although the IDS features a full-carbon-fiber body and it is unclear if any aluminum is used, the concept car is notable for being among the first fully operational autonomous vehicles. The IDS has two modes, a piloted drive that engages autonomous driving and a manual drive that allows the driver to take control of the vehicle. The EV power train for the IDS is fitted with a high-capacity 60 kWh battery. This along with its reduced weight and low stance design providing high aerodynamic performance, enables the IDS to cope with long-distance driving.

The Mitsubishi cars on display used little aluminum (with the exception of the Pajero, which has an aluminum hood). The company displays its eX concept car, a compact SUV powered by a EV system with twin, small, high output motors mounted in the front and rear that power the four wheels. The EV system utilizes a next-generation lithium-ion battery, which has an energy density twice as large as conventional batteries. The company reduced the weight of both the power train system and the body weight, achieving a cruising range of 400 km.

Japanese Demand Trends for Automotive Aluminum Products

Changes in the domestic production of vehicles in Japan in recent years are shown in Table I. As can be seen from the table, overall production recorded a slight year-on-year increase of 1.5% in 2014. In the case of passenger cars, the

	Passenger Cars	Trucks	Buses	Total
2007	9,944	1,538	114	11,596
2012	8,555	1,266	122	9,943
2013	8,189	1,308	133	9,630
2014	8,277	1,358	140	9,775
Change YoY (%)	101.1	103.8	105.3	101.5

(Source: Japan Automobile Manufacturers Association.)

Table I. Japan's total auto production (in 1,000 units).

increase was 1.1% year-on-year. However, generally speaking, the trend clearly shows that production is not growing.

September 2015 year-to-date data shows that domestic production of cars, trucks, and buses, totaled 6.9 million units, down almost 7% from the period a year prior due to sluggish domestic sales of passenger cars. Of the total, passenger cars accounted for 5.8 million units and production moved again to a decline.

According to data from the Japan Aluminium Association, shipments of castings and die castings, which make up almost 80% of the total shipped to the auto industry, dropped 1.5% in the first half of 2015 compared to the previous year, reflecting the decline of domestic auto production previously mentioned. Trends of domestic shipments of aluminum products to the auto industry are shown in Table II.

			2007	2013	2014	Change YoY (%)
Rolled and Extruded Products	Wheels		4,388	1,352	1,397	103.3
	Motorcycles		13,488	6,850	7,305	106.6
	Passenger Cars		124,595	114,287	117,724	103
	Trucks & Buses		29,396	30,318	34,580	114.1
	Heat Exchangers		153,844	117,769	119,995	101.9
	Subtotal		*325711*	*270576*	*281001*	*103.9*
	(Rolled)		(166,527)	(138,139)	(145,649)	(105.4)
	(Extruded)		(159,184)	(132,437)	(135,352)	(102.2)
Castings & Die Castings	Castings		3976,19	387,866	390,507	100.7
	Die Castings	Motorcycles	51,069	28,720	28,592	99.6
		Motorcars	936,669	851,841	869,017	102.0
	Subtotal		*1,385,357*	*1,268,427*	*1,288,116*	*101.6*
Forgings			33,414	25,912	26,254	101.3
Total			**1,774,482**	**1,564,915**	**1,595,371**	**101.9**

(Source: Japan Aluminium Association.)

Table II. Aluminum products shipments for automobile applications in Japan (in tonnes).

In contrast to casting and dies casting, shipments of rolled products to the industry marked a steady year-on-year increase of 3.3% in the same period. However, extruded products recorded a 4.7% fall. The reason behind the increase in rolled products is likely to be the upward trend in the use of aluminum auto body sheet (ABS), which has become apparent. (Figures related to production and shipments of auto body sheet are not being disclosed.)

Shipments to the domestic auto industry in the calendar year 2015 are estimated at over 25,000 tonnes, which is 15-20% higher than in 2014. Production, including exports to the U.S. and Chinese auto industries, are estimated to reach some 35,000 tonnes. Two domestic aluminum ABS producers, Kobe Steel, Ltd. and UACJ Corp., are building exclusive plants for ABS in China and the U.S., each having a rated annual capacity of around 100,000 tonnes. There is an expectation that demand for ABS in Japan will increase to about 100,000 tonnes per annum by 2020.