

# Murata's Technology

## Constant Evolution: Technology that Creates Customer Value

Murata has built an integrated system of production from raw materials to finished products, and we are consistently developing and accruing our proprietary technological base, such as in material development, process development, product design, manufacturing technology and the software, analysis and evaluation that supports that content. We develop such technologies flexibly through their mutual linkage and the close cooperation between engineers in each field in order to promptly satisfy our customers' needs. We also aim at creating new markets and innovation by actively collaborating with outside partners and by developing technologies and products that anticipate the future.

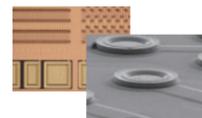
### Process development

Process development is designing the best manner of manufacture in order to concretely manifest the designed functions, and it plays an important role in the miniaturization, slimming down, and high functionality of electronic components. For example, the smallest monolithic ceramic capacitor in the world (0.25 x 0.125 mm) that we developed was realized using technology that Murata has accumulated for laminating and multi-layering of ceramic sheets in micron units. Our thin film and ultra-fine processing technology are also utilized in surface acoustic wave devices and MEMS application sensors.

#### <Our core technologies>



Sheet casting and stacking technology



Deposition and fine processing technology

- **Ceramic sheet lamination and stacking technology**  
Technology for casting thin dielectric sheets of uniform and minute crystalline particles, and precisely stacking hundreds of those sheets to a height of less than 1 mm
- **Printing technology**  
Technology for forming thin, dense internal electrodes and high-density wiring circuits on ceramic sheets
- **Deposition and fine processing technology**  
Technology for forming smooth, flat membranes at a micron-nano level and enabling processing with nano level accuracy. At Murata, we are also utilizing more highly evolved three-dimensional ultra-fine finishing technology for MEMS application devices.

### Manufacturing technology

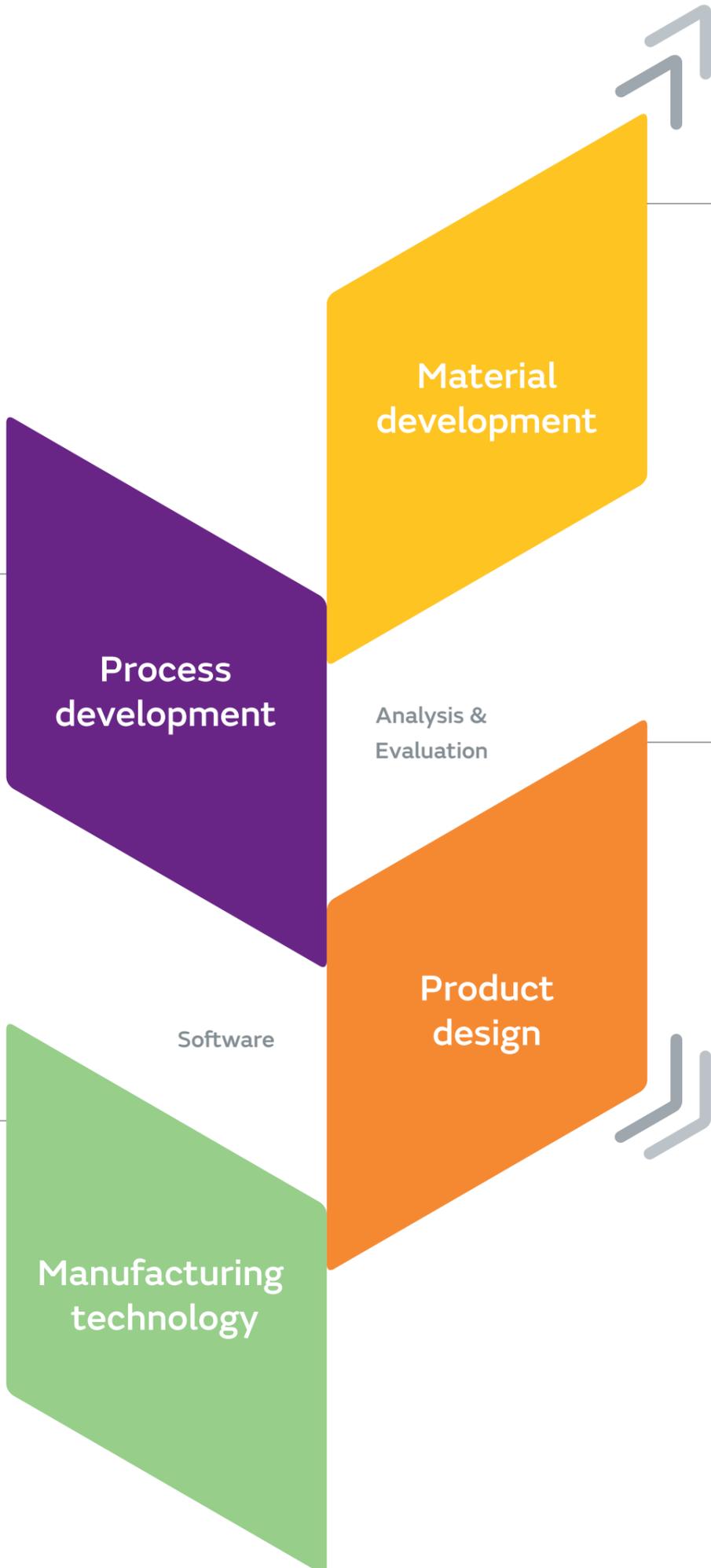
Murata employs in-house production facilities toward producing the optimal environment for *monozukuri* (manufacturing). Due to this, we currently possess numerous technologies and know-how in regard to mass-producing products stably and efficiently. Implementing development of that equipment right from the product development stage has also led to stable quality. Such manufacturing technology is what supports the foundation of *monozukuri* at Murata.

#### <Our core technologies>



Automatic machinery design technology

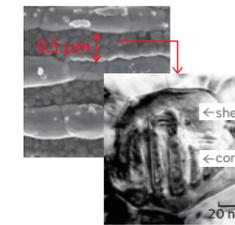
- **Automatic machinery design technology**  
Technology for designing production equipment that can deliver, with high precision and at high speed, the optimal in processing and assembly for making smaller products, thinner products, and products with more advanced features
- **Industrial Engineering**  
Technology for improving productivity by scientifically analyzing and managing the manufacturing site



### Material development

"New electronic devices begin with new electronic components; new electronic components begin with new materials..." Based on that concept, by constantly revisiting the sought-after functions, considering things all the way down to the material, and adhering to a posture of "management at the source and development from the source", Murata has achieved the creation of functional ceramic materials with outstanding characteristics. And the technology that we have cultivated with those ceramic materials is being further advanced through the development of even new materials that produce even new functions.

#### <Our core technologies>



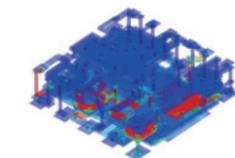
Ceramic particle core shell structure

- **Material design technology**  
Technology for designing the material composition and structure that delivers the characteristics and functions required of a particular material
- **Powder technology**  
Technology for synthesizing and manufacturing powder material by controlling the particle diameter and crystal structure of ceramics

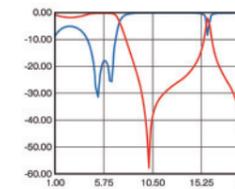
### Product design

From single-function components to modules and on to total solution proposals, the value that Murata has provided over the years continues to evolve. We are involved in development of the technologies and products that can promptly respond to customer needs with an eye on the future. Furthermore, the high frequency design technology that we accumulated from early on enables rapid product design and is behind the mobile device innovations that are evidenced by the rapid evolution of smartphones and tablets.

#### <Our core technologies>



Electromagnetic wave analysis



Passage and reflection characteristics of high frequency devices

- **High frequency design technology**  
Design technology that takes into consideration both the parasitic components that have minimal effect in the low frequency waveband and the complex electromagnetic coupling that exists between the circuits and its elements... In the design of components that are used in the high frequency band, we were able to achieve downsizing and greater functionality for high-frequency compatible products through a design process that considered such effects.
- **Simulation technology**  
Technology for performing virtual design and analysis in order to embody the concept design... Technologies into circuit simulation, electromagnetic field analysis, thermal analysis, and stress analysis result in an increase in the speed and efficiency of development and are widely utilized for solving a variety of other technological issues.
- **Modular design technology**  
Design technology for proposing circuit configurations that offer the required function by bringing out the ultimate in performance of each component, and that embodies the modular structure of the required size... As high capacity, higher speed communications services become more and more in demand, we are proposing smaller sized, lower profile, high functionality wireless communication modules.
- **Sensor element design technology**  
Design technology that uses functional materials and structures to embody the elements that can measure the present state of and changes in physical and spatiotemporal characteristics, etc... As miniaturization and high sensitivity progresses, numerous sensor elements are combined in various devices and the information acquired by those sensor elements is utilized in a diversity of applications.

