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Piezoelectric Crystals and Crystal Devices – Types, Materials, Applications, New Developments, Industry Structure and Global Markets

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Abstracts

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The markets for piezoelectric crystal products are characterized by price competition, rapid technological change, short product life cycles, and heightened global competition. Due to the increasing requirements for high-speed, high-frequency components as well as the entry of new competitors to the large market, there is intensified competition among existing crystal device suppliers.

The global piezoelectric crystal industry has gone through several boom-and-bust cycles. However, in the last five years, several applications have emerged for piezoelectric materials because of the new revolution in wireless and wire line communications. Markets have boomed in these areas especially for piezoelectric crystals. In addition, new developments in piezoelectric ceramics and ceramic/polymer composites have evolved new applications and markets. However, piezoelectric quartz crystals and crystal devices still hold a large market segment, and with the boom in the wireless industry, the average market growth rate reached double digits in the last five years.

STUDY GOAL AND OBJECTIVES

This study focuses on key piezoelectric crystal devices and provides data about the size and growth of the piezoelectric crystal devices markets, company profiles and industry trends. The goal of this report is to provide a detailed and comprehensive multi-client

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study of the markets in North America, Europe, Japan, China, Korea and the rest of the world (ROW) for piezoelectric crystal devices, as well as potential business opportunities in the future. The report covers the global market, industry structure, competition, profiles of leading manufacturing companies, and a patent analysis.

The objectives include thorough coverage of underlying economic issues driving the piezoelectric crystal device business, as well as assessments of new, advanced piezoelectric crystal devices that are being developed. Another important objective is to provide realistic market data and forecasts for piezoelectric crystal devices. This study provides the most thorough and up-to-date assessment that can be found anywhere on the subject. The study also provides extensive quantification of the many important facets of worldwide market development in piezoelectric devices. This, in turn, contributes to a determination of the kinds of strategic responses companies may adopt in order to compete in these dynamic markets.

Users of piezoelectric crystal devices in developed markets must contend with twin pressures: to innovate and, at the same time, to reduce costs. New applications for piezoelectric crystal devices have been proposed in recent years. This study condenses all of these business related issues and opportunities.

This report has been prepared to:

provide an overview of the various piezoelectric quartz crystals and devices, and their production technologies and applications;

identify the technological and business issues related to the commercial applications of piezoelectric quartz crystals and crystal devices;

analyze the domestic and foreign competition among companies within each segment of the market for piezoelectric quartz crystals and devices;

determine the current size and future growth of the markets for piezoelectric quartz crystals and devices;

determine the current size and future growth of the markets for piezoelectric non-quartz single crystals;

ascertain which piezoelectric technologies and applications will be winners until

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the year 2012;

identify and profile Japanese, European, North American, Chinese, Korean and “rest of world” producers and suppliers of piezoelectric crystals and crystal devices.

REASONS FOR DOING THE STUDY

The piezoelectric devices market is a diversified but attractive and still-growing multi-billion dollar market characterized by very high production volumes of a diversified range of piezoelectric devices that must be both extremely reliable and low in cost. Growth in the piezoelectric devices market continues to be driven by increasing demands in camera phones for autofocus mechanisms, piezo-transformers, energy harvesting devices, data storage, semiconductors, microelectronics production, precision mechanics, life science and medical technology, optics, photonics, nano-metrology, robots, toys, HVAC control systems, hand held consumer electronic devices, automotives sensors, ultrasonic transducers for medical imaging and non-destructive testing and vibration related applications, structure health monitoring, ultrasonic welding and cleaning, ceramic resonators for mobile phones and devices used for information and communication technologies.

The diversified piezoelectric crystal and crystal device business is complex and fast moving, with manufacturers increasingly adopting a truly global view of the market. Traditional piezoelectric devices have a broad customer base, and new applications have also emerging for these devices.

With this background of new emerging applications, iRAP felt a need to conduct a detailed study and update technology developments and markets. The report identifies and evaluates piezoelectric crystals and crystal devices and technologies which show potential growth.

CONTRIBUTIONS OF THE STUDY

Traditional piezoelectric crystal devices have a broad customer base, as frequency control devices and new applications such as sensors and optical devices are potential areas that have now entered the mainstream and are showing significant sales volumes. The diversified piezoelectric crystal device business is complex and fast moving, with manufacturers increasingly adopting a truly global view of the market. With

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this background of new emerging technologies and applications, iRAP felt a need to conduct a detailed study and update technology developments and markets.

The study covers the markets, materials, synthesis and fabrication techniques, and new developments in piezoelectric crystals and crystal devices, current and emerging applications, and a market analysis. Current size and future growth of the markets are estimated for the period 2007 to 2012. The report analyzes the competitive environment within each of the market segments and applications. The report profiles all leading global suppliers of piezoelectric quartz and non-quartz crystals and crystal devices.

SCOPE AND FORMAT

Three market segments have been analyzed – frequency control devices (quartz crystals, crystal oscillators, crystal filters SAW devices); sensor devices (accelerometers, temperature sensors, pressure sensors, quartz crystal microbalances); and optical devices (optical low pass filters). In addition to these we have provided market numbers for cultured quartz crystals and lumbered bars.

The qualitative and quantitative judgments embodied in this report are a valuable contribution to the current knowledge of piezoelectric quartz crystals, crystal devices. Moreover, this study has been conducted at a vital stage of the quartz crystal device industry, as decisions are to be made by a number of companies on their future strategies of expansion and reorientation due to the shift from the military to the commercial market.

TO WHOM THE STUDY CATERS

The study will benefit the existing manufacturers of piezoelectric actuators, ultrasonic motors, sensors, transducers, transformers, resonators and micro- energy harvesting devices that seek to expand revenues and market opportunities by expanding and diversify in vast applications of devices.

This report is directed to various types of companies that are interested in the developments in this field, such as:

- companies involved in the development, manufacturing and supplying of advanced materials;

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companies involved in the development, manufacturing and supplying of electronic devices;

manufacturers of cultured quartz crystals and lumbered bars;

manufacturers and suppliers of piezoelectric elements and devices;

manufacturers of telecommunication equipment and cellular telephones;.

companies involved in smart materials, nanotechnology and MEMS devices;

manufacturers of advanced materials and electronic components interested in diversification;

venture capital companies, angel investors and financial institutions interested in new and attractive investments.

REPORT SUMMARY

The emergence of wireless communications and the increased need for data transmission using wireline communications has created a booming market for piezoelectric quartz crystals and crystal devices. Several new industrial and consumer applications have emerged, steering the industry from over-dependence on military demand to commercial applications.

In high bandwidth systems, data transfer needs to be synchronized, creating a high demand for timing products. Crystal devices provide the precise timing signals needed to ensure reliable data transfer at high speeds in applications ranging from notebook computers to network switches. As systems continue to grow in processing power and complexity, the demand for these products will accelerate. The demand for higher precision will also continue to increase as timing margins shrink in higher bandwidth systems. New high-end cell phone applications require low voltage, small packages and very low resistance to provide the highest fidelity sound. These mobile phones also offer functions beyond simple voice communication, including PDAs, digital still cameras and digital media players, with very low power consumption for extended battery life and increased need for coordination among functions.

The continuing increase in electronic sophistication, as well as the penetration and

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proliferation of electronic products into new consumer and commercial applications, puts new demands on frequency control devices. This creates both technological challenges and new business opportunities for products offering faster speeds, higher stability relative to temperature, smaller surface-mountable packaging and lower unit cost.

In the 1980s, Japan was the world leader in mass-produced piezoelectric crystals and crystal devices. However, in the later part of the 1990s, the balance shifted, with China and Korea taking over the low-end products. Japan still supplies the expensive and high-end products. At present, Japan and Korea are supplying quartz devices for microprocessor products and extended temperature products. China is supplying large quantities of low end products for such application as toys and games.

Major findings of this report are:

The major findings of this report can be summarized as follows:

The global piezoelectric crystal industry is characterized by over 450 companies involved in the industry as manufacturers and suppliers.

The 2007 global market is expected to reach $4.8 billion and will increase further to $6.91 billion by the year 2012, with an annual average growth rate of 7.5%.

Among the seven market segments of piezoelectric crystal frequency control devices, telecommunication has the largest market share, as much as 30%, followed by consumer applications including video games, audio, visual and amusement (20%), computing (17%), military and government (10%), automotive (9%), industrial (8%), and medical (6%).

During 2007, crystal units (resonators) and filters shared 62% of the total market, followed by oscillators and real time clock modules (32%). Sensors and optical devices market shares are about 3% each.

Acoustic wave technologies account for 21.4% of the devices made from crystal wafers.

In 2007, Japan has the highest market share of 50%, followed by North America with 20%, Europe with 15%, China with 8%, and the rest of the world with 7%.

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By 2012, China’s share will be 11%, positioning it close to Europe with 13% share of the global market.

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APPENDIX I - SPECIFICS OF SELECTED KEY IEEE NETWORKS

APPENDIX II – FREQUENCY SPECTRUM ALLOCATION IN PROTOCOLS

APPENDIX III – TERMS USED IN WIRELESS COMMUNICATION

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