NEWS RELEASE

NTT

NIPPON TELEGRAPH AND TELEPHONE CORPORATION

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Compact lasers generate specified arbitrary wavelength light

- Suitable for applications in biotechnology, medicine and environmental measurement -

Nippon Telegraph and Telephone Corporation (NTT) has developed a technology capable of realizing a solid-state laser with a specified arbitrary wavelength, which had until now been impossible with semiconductor lasers. The commercialization of this new technology is promoted through "Comprehensive Commercialization Functions[*1]" which is started in July 2003 to directly promote the commercialization of prominent research achievements. The alliance with other corporations could be intended for the commercialization and the products are planed to be in the market in summer 2004. This new technology provides a high output, a longer operating life and ease of maintenance in a palm-sized device. It is also priced lower than conventional lasers. We anticipate that there will be great demand in the fields where large gas lasers are currently used and also the biomedical field such as analysis of DNA or cell function and environmental measurement for NOx or SOx.

<Background to the development>

Lasers are categorized by their emission sources. For example, there are gas lasers (e.g. the argon laser), solid-state lasers (e.g. the Nd:YAG laser), and semiconductor lasers. Semiconductor lasers have become more common because they are small, light and inexpensive. They are employed mainly in the visible and near infrared region and used for recording media including CDs and DVDs as well as in the telecommunication field (see Fig. 1).

However, there are wavelength regions for which semiconductor lasers cannot be realized. For example, in the 0.5 - 0.6 μm region (green, yellowish-green, orange) or the 2-5 μm region (mid-infrared), other emission sources have been used, which are more expensive and require more power consumption than semiconductor lasers. NTT has worked on the development of a compact laser which is available for these regions and also generate arbitrary wavelength; we intended to invent a "custom-made compact laser".

<Technological points>

The essence of the technology is to combine highly efficient optical non-linear crystal[*2] and high-output semiconductor laser for telecommunication by using the optical device technology for wavelength conversion. Figure 2 shows the principle used to generate the wavelength converted light. Incident lasers with different frequencies (wavelengths) input into an optical nonlinear crystal generate a laser light with a frequency (wavelength) that matches the sum of the input frequencies or the difference between them.

NTT Photonics Laboratories have worked on research and development of wavelength converting technology for optical communication by using $LiNbO_3$ (lithium niobate)[*3] as optical nonlinear crystal. In the result of it, we devised our own method generating optical nonlinear crystals, which enables high conversion efficiency and reliability. We succeeded in getting converting light intensity, which is 10 times more than usual, by combining the optical non-linear crystal which is designed for out-of band communication wavelength and high-output semiconductor laser. It is possible to generate laser lights with specified wavelength in the region from 500nm (1 nano is one billionth) to 5㎛ (1 micro is one millionth) by this technology and controlling the design width of optical non-linear crystal and wavelength of communication semiconductor (see Fig. 3).

<Technical features>

The newly developed laser has the features shown below, which we expect will be able to reduce the size of existing gas lasers and realize low power consumption simultaneously.

The output power is 10 mW (30 mW is also available)

- The device is smaller and operates at a lower power than a conventional gas laser.
- This laser is easier to maintain than a gas laser because of its long operating life.
- An external modulator is unnecessary because direct modulation is possible.
- Continuous operation at room temperature is possible even in the mid-infrared region of 2 or more micrometers.

<Applicable region>

The expected application areas for the lasers are shown below (also see Fig. 4).

- Flow cyte-meters or confocal laser microscopes, which are used for biotechnological field applications such as cell or DNA analysis.
- Light sources for environmental gas sensors such as carbon dioxide (CO_2), nitrogen oxide (NO_x) , sulfur oxide (SO_x), and various organic gases.
- As a replacement for sodium D ray lamps used to analyze the components of medical products, foods and chemicals.
- Continuous operation at room temperature is possible even in the mid-infrared region of 2 or more micrometers.

We anticipate that there will be new or substitute demands for products in various regions. For example, the alliance with Kyoto Electronics Manufacturing Co., Ltd. and SC Bioscience Corporation are examined.

<Prospects>

The technology is expected to be made commercially available by NTT Electronic Co. and marketed in summer 2004, taking full advantage of "Comprehensive Commercialization Functions".

<Glossary>
*1 Comprehensive Commercialization Functions
The special producers appointed for commercialization directly promote to put the prominent research of NTT laboratories into market, keeping cooperation with NTT grouped companies and other outside companies.

*2 Nonlinear optical crystal
A crystal whose refractive or absorption index depends on the intensity of the incident laser light. It is used for wavelength conversion including optical modulator or second harmonic generation (SHG).

*3 $LiNbO_3$ (lithium niobate)
The electro-optical effect is the best of all practical materials. It is widely used for high speed modulator for optical communication.

- (Fig.1) Current Commercialized LDs
- (Fig.2) Technological Points
- (Fig.3) Compact Lasers at Specified Arbitrary Wavelength
- (Fig.4) Product Lineup

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