Professor Kodo Kawase
Nagoya University

Professor Kawase (left) and his colleagues looking at a millimetre-wave reflection spectrometer in his laboratory at Nagoya University

PROFESSOR KODO KAWASE received a PhD degree in electronic engineering from Tohoku University in 1996, became an Initiative Researcher at RIKEN in 2001, and Professor of the Graduate School of Engineering, Nagoya University in 2005. He received the 2000 and 2006 Prizes for Laser Engineering from the Laser Society of Japan; the 2002 Research and Encouragement Award and the 2006 Special Research Award from the Marubun Research Promotion Foundation; and the 2005 Young Scientists Prize from the Minister of Education, Culture, Science and Technology (MEXT).

Q. What inspired you to become a researcher?
A. When I was a bachelor student in the School of Electrical and Electronic Engineering at Kyoto University, in 1988, I became interested in the Fröhlich hypothesis that suggests a possible non-thermal effect of terahertz or millimetre frequency waves on human cell activity. I learned that the lack of a widely tunable source that covers terahertz and millimetre frequencies was hindering the proof or otherwise of this hypothesis.

Q. How did you get started in your academic career? When did you start working in the terahertz field?
A. When I started my PhD studies, in the Research Institute of Electrical Communication in Tohoku University in 1992, I persuaded my supervisor to let me start my research on a widely tunable terahertz source using nonlinear optical effects. Little did I know that this would be the beginning of a long struggle until I finally succeeded in developing an injection seeded terahertz parametric generator in 2000. Since I formed my own research team in RIKEN in 2001, I have also been working on spectroscopic terahertz imaging using our own tunable sources.

Q. Has the terahertz field developed as you might have expected? What have been the biggest surprises?
A. Since Dr. Nuss’s research group at AT&T Bell Laboratories succeeded in demonstrating terahertz frequency imaging in 1995, the field has always been developing much faster, wider, and deeper than I expected. The biggest surprise for me was the demonstration of extremely intense terahertz pulse generation from LiNbO3 crystal using Cherenkov phase-matching by Dr. Hebling and Dr. Nelson of MIT in 2008. They realised as high as 10 μJ/pulse terahertz parametric generation using a REGEN Ti:sapphire laser as a pump source.

Q. Tell us a little bit about your current research activities.
A. Recently, we proposed a prism-coupled Cherenkov phase-matching (PCC-PM) method, in which a prism with a suitable refractive index at terahertz frequencies is coupled to a thin nonlinear crystal [Opt. Exp., 2010, 18, pp. 3338–3344]. This has the following advantages: many crystals can be used as terahertz-wave emitters; the phase-matching condition inside the crystal does not have to be observed; the absorption of the crystal does not prevent efficient generation of radiation; and pump sources with arbitrary wavelengths can be employed. We demonstrated PCC-PM terahertz-wave generation using the organic crystal DAST and a silicon prism coupler. We obtained terahertz-wave radiation with tunability between approximately 0.1 and 10 THz, and with no deep absorption features resulting from the absorption spectrum of the crystal.

Q. Within your area, what are the key challenges?
A. We really hope someone drastically reduces the price of pump lasers such as the Nd:YAG laser or femtosecond fibre lasers. The cost of the pump laser dominates the cost of our terahertz sources.

Q. It has often been said that ‘terahertz is a solution looking for a problem’ – do you agree?
A. Of course I do not agree. I have consulted more than 100 Japanese companies on possible real-life applications of terahertz technology, and I know there are many problems in industry that can be solved by terahertz technology. Terahertz technology will be very useful in many companies if the prices of terahertz systems are drastically reduced, and if the signal-to-noise ratio of the terahertz systems increase. These are ‘technical’ problems that will be solved in the near future.

Q. What do you see as the prospects for exploiting terahertz Technology, and what are the key barriers?
A. Applications using terahertz waves have been considered for many years, however, at present there is no available system that can be fully implemented in practical situations. Much research still needs to be performed to achieve a sufficient level of sensitivity, reliability, portability, and flexibility, all of which are essential for industrial applications.

Q. What one key thing would transform the terahertz field?
A. A highly sensitive terahertz camera.