

## Terahertz Science, Technology and Application Trends

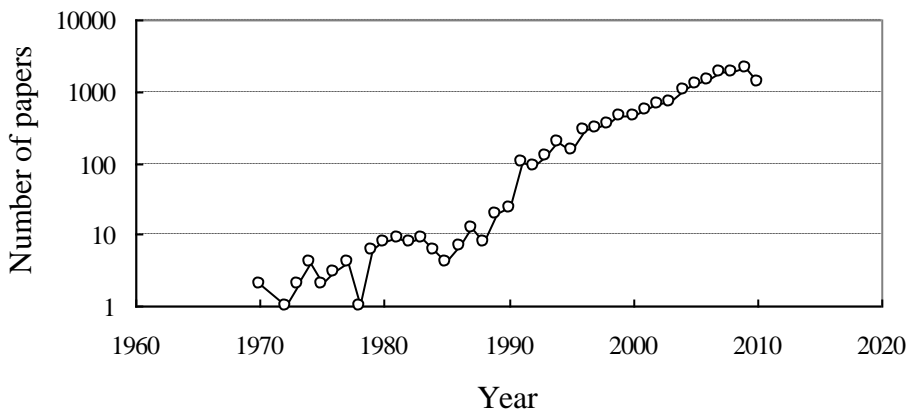
Yang Fan, Wang Haixia, Han Lin, Leng Fuhai

National Science Library, Chinese Academy of Sciences

Email: yangf@mail.las.ac.cn

Terahertz radiation (THz) lies in the gap between the microwave and infrared regions. Recent progress in THz science and technology is now receiving increasing attention around the world. Some scientists believe that research in the THz band in the 21st century will become one of the most promising research areas for transformational advances in biology and physics, as well as in other interdisciplinary fields.

We used the logistic growth model to fit the publication record trends of THz related papers (the number of papers versus time). The inflexion points of the mathematical equation revealed the most important growth periods: beginning fast growth period (1970-2003), the fastest growth period (2003-2015), and gentle growth period (2015- ). Then it is credible to forecast that the fastest growth of the number of publications will continue for at least 3-4 years, based on mathematical modeling.

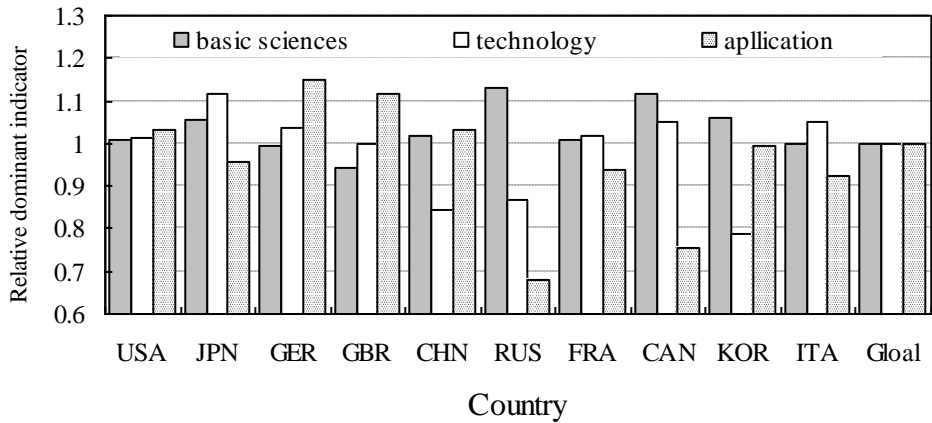


**Figure 1.** Number of papers published each year (1970-2010) with the keyword “THz” in the title or in the abstract in log scale.

Bibliography indicators accompanied by a commercial data analyzer helped to uncover more details of THz studies. For example, THz science and technology were mainly studied by the applied physics, optics, engineering-electrical-electronic scientists, as well as other science communities, such as materials science, spectroscopy, chemistry, astronomy and astrophysics, biophysics et al., where multidisciplinary studies were common.

By clustering the key words of the papers, the studies can be explained in three themes: more than half of the studies focused on the basic science studies, about 1/3 of the studies focused on specialized technology developments, and a little less than 1/4 of the studies focused on THz science and technology applications.

The relative citation influences of papers written by authors from USA, Germany, UK, Netherlands, Switzerland, and Denmark were higher. A more striking feature of studies of different countries was the disequilibrium among THz radiation and characteristic study, THz generation, detection and simulation, and THz applications.



**Figure 2.** Relative percentages of each country in THz basic sciences, technology and application studies to the global mean values

On the other hand, patent applications were more active in Japan and USA. Particularly, Japanese institutions dominate patenting technologies. We summarized two innovation patterns – industry-based and research community-based.

Additionally, we integrated the market reports to determine the present THz market values and the possible size of it in the future.

Finally, by comparing the numbers of papers with those of patents, we concluded that the global THz science and technology studies had large potentials to acquire breakthroughs in the basic science studies and technology developments, as well as an emerging THz application market.