

## **Microbial Biotechnology Powered by Genomics, Proteomics, Metabolomics and Bioinformatics**

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### **Abstract**

Microorganisms have been widely employed for the production of useful bioproducts including primary metabolites such as ethanol, succinic acid, acetone and butanol, secondary metabolites represented by antibiotics, proteins, polysaccharides, lipids and many others. Since these products can be obtained in small quantities under natural condition, mutation and selection processes have been employed for the improvement of strains. Recently, metabolic engineering strategies have been employed for more efficient production of these bioproducts. Metabolic engineering can be defined as purposeful modification of cellular metabolic pathways by introducing new pathways, deleting or modifying the existing pathways for the enhanced production of a desired product or modified/new product, degradation of xenobiotics, and utilization of inexpensive raw materials. Metabolic flux analysis and metabolic control analysis along with recombinant DNA techniques are three important components in designing optimized metabolic pathways. This powerful technology is being further improved by the genomics, proteomics, metabolomics and bioinformatics. Complete genome sequences are providing us with the possibility of addressing complex biological questions including metabolic control, regulation and flux. In silico analysis of microbial metabolic pathways is possible from the completed genome sequences. Transcriptome analysis by employing DNA chip allows us to examine the global pattern of gene expression at mRNA level. Two dimensional gel electrophoresis of cellular proteins can be used to examine the global proteome content, which provides us with the information on gene expression at protein level. Bioinformatics can help us to understand the results obtained with these new techniques, and further provides us with a wide range of information contained in the genome sequences. The strategies taken in our lab for the production of pharmaceutical proteins, polyhydroxyalkanoate (a family of completely biodegradable polymer), succinic acid and fine chemicals by employing metabolic engineering powered by genomics, proteomics, metabolomics and bioinformatics will be presented.

## **Curriculum Vitae**

### **Sang Yup Lee**

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#### **Education :**

B.S., Dept. Chemical Engineering, Seoul National Univ., Seoul, Korea (1982. 3. 1-1986. 2.29)

M.S., Dept. Chemical Engineering, Northwestern Univ., Evanston, IL, USA (1986. 9.1-1987. 6.30)

Ph.D., Dept. Chemical Engineering, Northwestern Univ., Evanston, IL, USA (1987.7.1-1991.10.31)

#### **Professional Experience:**

1. Senior Researcher/Postdoc, BioProcess Engineering Research Center, KAIST (1992.1 – 1994.2)
2. Session Chair, Food Processing Technology, International Meeting on Chemical Engineering and Biotechnology, Frankfurt, Germany, June, (1994)
3. Editor, Biotechnology News (1995)
4. Session Chair, CHEMECA/BioCHEMECA'95, Adelaide, Australia, August, (1995)
5. Committee Member & Participating Professor, Biomedical Research Center, KAIST (1995 - present)
6. Editorial Board Member, Bioindustry News (1996 - 1999)
7. Planning Board Member, Korea Institute of Biotechnol. and Bioeng. (1996 - 1998)
8. Assistant Editor, Biotechnology and Bioprocess Engineering (1996- 1999)
9. Scientific program Board Member, Korea Institute of Biotechnology and Bioengineering (1997- present)
10. Participating professor, Brain Science Research center (1997- present )
11. Committee Member, The Life Science Research Institute, KAIST (1997- present)
12. Reviewing Committee Member, KTmark, Korea Industrial Technology Association(1997-present)

13. Secretary of Public Relations, Biochemical Engineering Division, KIChE (1997- present)
14. Organizing Committee Member, Session chair, Biochemical Engineering XI, Engineering Foundation, USA (1998-1999)
15. Reviewing Committee Member, IR52 Jang Young Sil Award, Korea Industrial Technology Association (1999-present)
16. Technology consultant, Korea Institute of Industrial Technology Evaluation and Planning (1999-present)
17. Session Chair, The 7<sup>th</sup> SPSJ International Polymer Conference (1999)
18. Organizing Committee member, International Symposium on Bacterial Polyhydroxyalkanoates (1999-2000)
19. Editorial Board Member, Biotechnology and Bioprocess Engineering (1999-present)
20. Member of the Planning Board, New Technology Division, Ministry of Commerce, Industry and Energy (2000)
21. Editorial Board Member, Bioprocess and Biosystems Engineering, Springer Velag, Germany (2000-present)

**Honors/Awards :**

1. The First China-Korea Young Researcher's Award -Engineering division, Ministry of Education, China & Korea-China Cultural Foundation (1996).
2. Excellent Research Award, KAIST (1997).
3. The First Young Scientist's Award (Engineering), The President of the Republic of Korea (1998).
4. Honored Member, "International Who's Who of Professionals" (1998- present).
5. New Academic Research Award, Korean Society for Biotechnology and Bioengineering (1998)
6. New Century Award, The BARONS 500, BARONS WHO'S WHO(USA) Leaders for new century (1999)
7. New Knowledge Leader in Science and Technology, The Ministry of Science and Technology (1999)
8. Top two author of the most cited SCI journal paper, ISI (1999)
9. The First Elmer Garden Award, Biotechnology and Bioengineering (John Wiley & Sons, USA) – American Chemical Society (San Francisco National Meeting) (2000)

Journal paper publications: 118 papers

Proceedings paper publications: 103 papers published

Conference presentations/Abstracts: 225 papers

Plenary/Keynote/Invited Lectures/Seminars: 76 presentations

Books Edited: 7 books

Essays: 26 articles

Patents: 41 patents