过程工程所名誉研究员聘任仪式暨SKIPER学院海外名师讲堂第2讲

**多相颗粒系统的三维X射线断层表征、分析与模拟**

3D Characterization, Analysis, and Simulation of Multiphase Particulate Systems Using X-ray Computed Tomography



演讲嘉宾：Jan D. Miller 教授

美国犹他大学冶金工程系主任

美国犹他大学Ivor Thomas杰出教授

美国工程院院士

演讲主持：齐涛研究员

演讲时间：2011年3月6日（星期日）9:00-10:30（提前十分钟入场完毕）

演讲地点：过程大厦308

演讲语言：英 语

主 办：人事教育处 综合办公室 湿法冶金国家工程实验室

**嘉宾简介：**

Jan D. Miller教授，美国工程院院士，现任犹他州大学冶金工程系主任、博士生导师。他的研究涵盖矿物加工和选煤工艺领域，专攻粒子系统、溶液化学、胶体与表面化学、环境处理技术。涉及湿法冶金、浮选化学和粒子技术方面的进一步研究。目前的工作包括开发x射线断层技术，以便研究复杂粒子系统的三维解析，包括解放/风险分析和在线煤炭可选性分析。还有开发天然碱工业的浮选技术，磁活性炭的制备，堆浸作业设计/操作的改良等项目正在进行中。自1968年，Miller博士加入犹他州大学以来，已获得25项专利，为学校获得的专利收入已超过75万美元。在过去10年中，支持Miller博士研究项目的经费累计超过1千万美元。他撰写/共同撰写的出版物达400多部。

**报告简介：**

在过去10年中X 射线三维断层呈像技术被应用于多相颗粒定性分析研究中。 利用专业软件建立多相系统中各相的三维立体特征及立体组织结构可以在3小时内完成对包含30，000个颗粒的多相系统进行分析。现今，随着X射线光谱技术的发展，利用透镜X射线显微CT系统，呈像的分辨率被提高了一个数量级。针对高分辨率X射线显微CT系统研发的三维成像分析软件已经应用于许多矿物加工的重要研究领域包括矿物破碎（颗粒破坏和取向晶界断裂）、矿物解离（矿物解离限制的纯度/回收率曲线和洗煤）、以及过滤/堆浸（颗粒堆空隙机构和LB流体力学模拟）研究中。

**背景材料参考：**

1. [1] J.D. Miller, C.L. Lin and A.B. Cortes, "A Review of X-Ray Computed Tomography and Its Applications in Mineral Processing", *Mineral Processing and Extractive Metallurgy Review*, 7 (1990) 1­-18.
2. C. L. Lin, J. D. Miller and C. Garcia, “Saturated flow characteristics in column leaching as described by LB simulation”, *Mineral Engineering*, Vol, 18 (2005) 1045-1051.
3. C.L. Lin and J.D. Miller, “3D characterization and analysis of particle shape using X-ray microtomograph (XMT)”, *Powder Technology*, 154 (2005) 61-69.
4. X. Li, C.L. Lin, J.D. Miller and W.P. Johnson, “Pore-scale Observation of Microsphere Deposition at Grain-to-Grain Contacts over Assemblage-scale Porous Media Domains Using X-ray Microtomography”, *Environ. Sci. Technol*., 40 (2006) 3762-3768.
5. X. Li, C.L. Lin, J.D. Miller and W.P. Johnson, “Role of Grain-to-Grain Contacts on Profiles of Retained Colloids in Porous Media in the Presence of an Energy Barrier to Deposition”, *Environ. Sci. Technol*., 40, (2006) 3769-3774.
6. A. R. Videla, C.L. Lin and J.D. Miller, “Watershed Functions Applied to a 3D Image Segmentation Problem for the Analysis of Packed Particle Beds”, *Part. Part. Syst. Charact*. 23 (2006) 237-245.
7. A.R. Videla, C.L. Lin and J.D. Miller, “3D Characterization of Individual Multiphase Particles in Packed Particle Beds by X-ray Microtomography (XMT)”, *International Journal of Mineral Processing*, 84 (2007) 321-326.
8. M.C. Sukop, H. Huang, C.L. Lin, M.D. Deo, K. Oh, and J.D. Miller, “Distribution of Multiphase Fluids in Porous Media: Comparison between Lattice Boltzmann Modeling and Micro-x-ray Tomography,” *Physical Review E*, 77(2) (2008) 026710-1-026710-7.
9. A.R. Videla, C.L. Lin, and J.D. Miller, “Simulation of Saturated Fluid Flow in Packed Particle Beds – The Lattice-Boltzmann Method for the Calculation of Permeability from XMT Images,” *Journal of the Chinese Institute of Chemical Engineers*, 39 (2008) 117-128.
10. M.I. Al-Wakeel, C.L. Lin, and J.D. Miller, “Significance of Liberation Characteristics in the Fatty Acid Flotation of Florida Phosphate Rock,” *Minerals Engineering*, 22(3) (2009) 244-253.
11. D. Garcia, C.L. Lin, and J.D. Miller, “Quantitative Analysis of Grain Boundary Fracture in the Breakage of Single Multiphase Particles using X-ray Microtomography Procedures,” *Minerals Engineering*, 22(3) (2009) 236-243.
12. J.D. Miller and C.L. Lin, “High Resolution X-ray Micro CT (HRXMCT) – Advances in 3D Particle Characterization for Mineral Processing Operations,” in *Recent Advances in Mineral Processing Plant Design*, D. Malhotra, P.R. Taylor, E. Spiller, and M. LeVier, eds., SME, Littleton, Colorado (2010) 48-59.
13. J.D. Miller, C.L. Lin, L. Hupka, and M.I. Al-Wakeel, “Liberation-Limited Grade/Recovery Curves from X-ray Micro CT Analysis of Feed Material for the Evaluation of Separation Efficiency,” *International Journal of Mineral Processing*, 93 (2009) 48-53.