**报告人：**陈晖，博士，金辰股份高级工程师，主要研究方向为光伏/半导体PECVD镀膜设备，曾获“中国有色金属科技进步一等奖”（省部级）2次，获“湖南省技术发明一等奖”（省部级）1次，发表学术论文12篇，其中，SCI 1篇，EI 6篇，CSCD 4篇，授权专利30余项。

**Speaker: Chen Hui,** Doctor, Senior engineer of Jin Chen Co., Ltd, The main research direction is Photovoltaic/Semiconductor PECVD coating equipment. Has won the “First prize of science and technology of China Nonferrous Metals Industry” (provincial and ministerial level)twice. Has won the "first prize of technological invention of Hunan Province" (provincial and ministerial level) once. Has published 12 academic papers, including 1 SCI, 6 EI, 4 CSCD and more than 30 authorized patents.

**题目：**管式PECVD制备钝化发射极-背钝化接触高效太阳电池技术及装备

**Title:** Technology and equipment of tube PECVD for the realization of Passivated Emitter and Rear Tunnel Oxide Passivation contact high efficiency solar cells

**摘要：**多晶硅/氧化硅(poly-Si/SiOx)双层钝化接触是近年来涌现的一种高效晶硅太阳电池技术，其特点是具有和异质结（HJT）类似的电池效率，并与目前主流的PERC技术相兼容。实验室电池记录达到25.7%，量产平均效率到达23.5%。近一两年是该技术推向产业化的关键时期，许多企业正在规划量产，其中关键的设备是poly-Si/SiOx的沉积设备。目前可供量产poly-Si/SiOx的沉积设备主要是低压化学气相沉积设备(LPCVD)。经过几年的努力LPCVD已经从实验室研发走到了大规模量产应用，被认为是一种可靠的生产设备，然而它也存在一些技术难点，如绕镀和非原位掺杂。等离子体增强化学气相沉积（PECVD）可以有效降低绕镀、并可以进行N-型和P-型的原位掺杂。 Meyer Burger开发了板式PECVD设备（CAiA），并和SERIS一同开发了应用PECVD技术实现高效太阳电池的制备工艺。

金辰股份旗下的苏州拓升智能装备有限公司与中科院宁波材料技术与工程所合作开发了管式PECVD设备用于poly-Si/SiOx的制备；并开发了poly-Si/SiOx的制备工艺。目前该设备在业内某龙头电池厂家进行电池全线工艺开发与验证。初步结果表明该设备具有运行稳定、低粉尘、低绕镀、无爆膜等特点。该设备将poly-Si和SiOx集成在一起，实现原位掺杂非晶硅（a-Si:H）的高速沉积和N 2O等离子体氧化二合一工艺。 Poly-Si的片间和片内非均匀度分布为4%和3%；SiOx的片间和片内非均匀度分布为3%和2%；iVoc大于740mV，钝化效果优异。目前正在进行高效太阳电池的制备，预计近期内可实现太阳电池平均效率≥23.5%。目前设备的设计是5管PECVD，产能是5500片/小时。我们可以根据客户的需求进行非标定制，将正面Al2O3，SiNx，背面poly-Si，SiOx，SiNx集成在同一设备中。总之我们开发的管式PECVD设备和工艺为高效钝化接触太阳电池的生产提供了一种具备高效率、低成本的新方法和技术路线。

**Abstract:** Polycrystalline silicon / silicon oxide (poly-Si/ SiOx) double-layer passivation contact is a high-efficiency crystalline silicon solar cell technology emerging in recent years. Its characteristics are similar to the efficiency of heterojunction (hjt), and compatible with the current mainstream PERC technology. At present, the laboratory battery record has reached 25.7%, and the average mass production efficiency has reached 23.5%。Nearly one or two years is a critical period for the industrialization of this technology. Many enterprises are planning mass production, among which the key equipment is poly-Si/SiOx deposition equipment. At present, Low Pressure Chemical Vapor Deposition (LPCVD) is the main deposition equipment for poly-Si/SiOx production. After several years of efforts, LPCVD has been developed from laboratory to large-scale mass production application, which is considered as a reliable production equipment. However, it also has some technical difficulties, such as back wrapping and Non-in-situ doping. Plasma Enhanced Chemical Vapor Deposition (PECVD) can effectively reduce the back wrapping and realize in-situ doping in n-type and p-type silicon. Meyer burger has developed the plate type PECVD equipment (CAiA), and developed the process of high efficiency solar cell with PECVD technology together with SERIS.

Suzhou Tuosheng Intelligent Equipment Co., Ltd. under Jinchen Co., Ltd. cooperated with Ningbo Institute of materials technology and engineering of Chinese Academy of Sciences to develop tubular PECVD equipment for the preparation of poly-Si/SiOx, and developed the preparation process of poly-Si/SiOx. At present, the equipment has been developed and verified by a leading battery manufacturer in the industry. The preliminary results show that the equipment has the characteristics of stable operation, low dust, low back wrapping and no film explosion. In this equipment, high speed deposition of in-situ doped amorphous silicon (a-Si: H) and N2O plasma oxidation are realized. The nonuniformity of poly-Si is 4%(among silicon wafers) and 3% (in silicon wafer), that of SiOx is 3%(among silicon wafers) and 2% (in silicon wafer), and that of iVOC is more than 740mV. The preparation of high-efficiency solar cells is under way, and the average efficiency of solar cells is expected to be ≥ 23.5% in the near future. At present, the design of the equipment is 5-tube PECVD with a capacity of 5500 pieces/hour. We can make non-standard customization according to customers' needs, integrating Al2O3, SiNx on the front of the battery, poly Si, SiOx and SiNx on the back of the battery into one device. In a word, the tubular PECVD equipment and process developed by us provide a new method and technical route with high efficiency and low cost for the production of high efficiency passivation contact solar cells.