Development of Recovery and Removal Techniques of Dilute Reactive Nitrogen to Realize Nitrogen Circulating Society

Presenter : SASAKI Yukichi（Japan Fine Ceramics Center）
PM：Dr. WAKIHARA Toru, The University of Tokyo
Implementing organizations : The University of Tokyo,
National Institute of Advanced Industrial Science and Technology (AIST),
Japan Fine Ceramics Center (JFCC), Mitsubishi Chemical Corporation

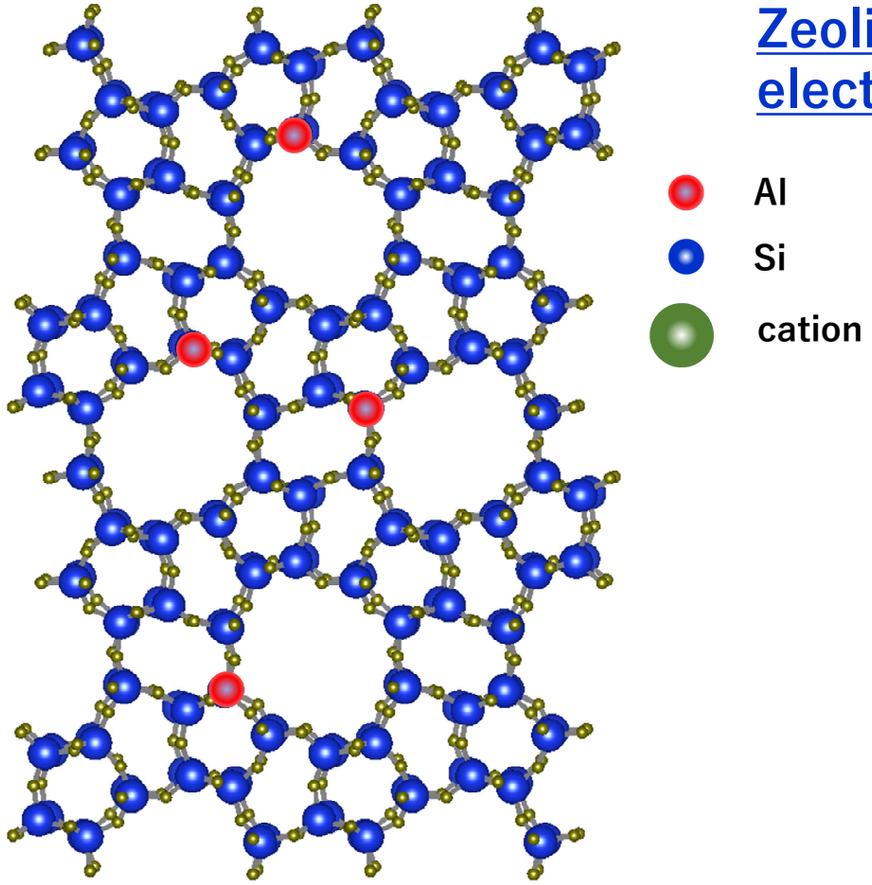
Targets for fiscal 2029

In addition to further upgrading the electron microscope observation technology, we will evaluate and analyze the microstructure of nanoporous materials to elucidate knowledge that will contribute to higher performance, and achieve mass production technology for implementation in pilot facilities.

Development of new catalysts and their practical application processes

Microstructure analysis is necessary

Zeolites sensitive to electron irradiation require the establishment of electron microscopy measurement conditions



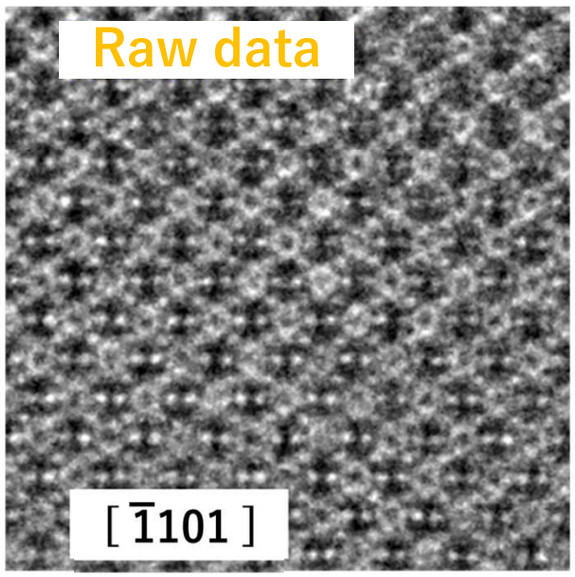
Research Items

1) Direct observation of cations in zeolites
2) Compositional analysis of zeolite with spatial resolution of 10 nm or less
   (Quantitative analysis & mapping of Si/Al ratio)
3) Structural defect analysis of zeolite catalysts
4) Crystal growth mechanism analysis of zeolite catalysts
5) Catalyst development support

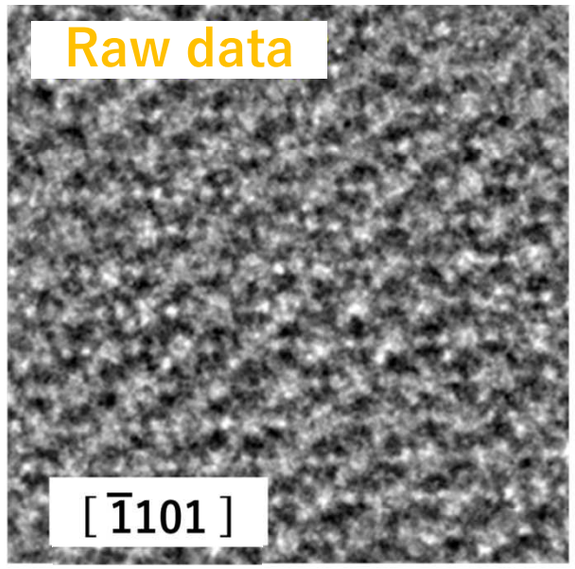
1） High resolution structural analysis

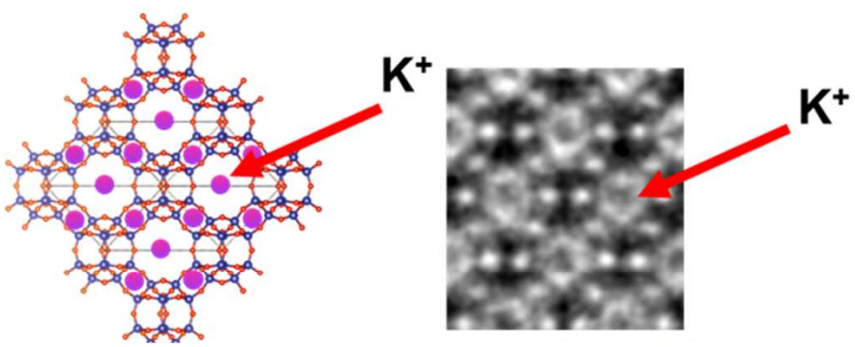
Direct observation of cations by TEM method

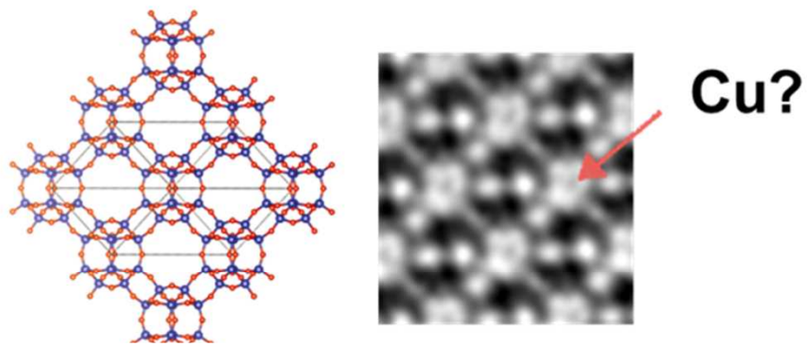
Direct observation of the cation in K-CHA



Direct observation of the cation in Cu-CHA







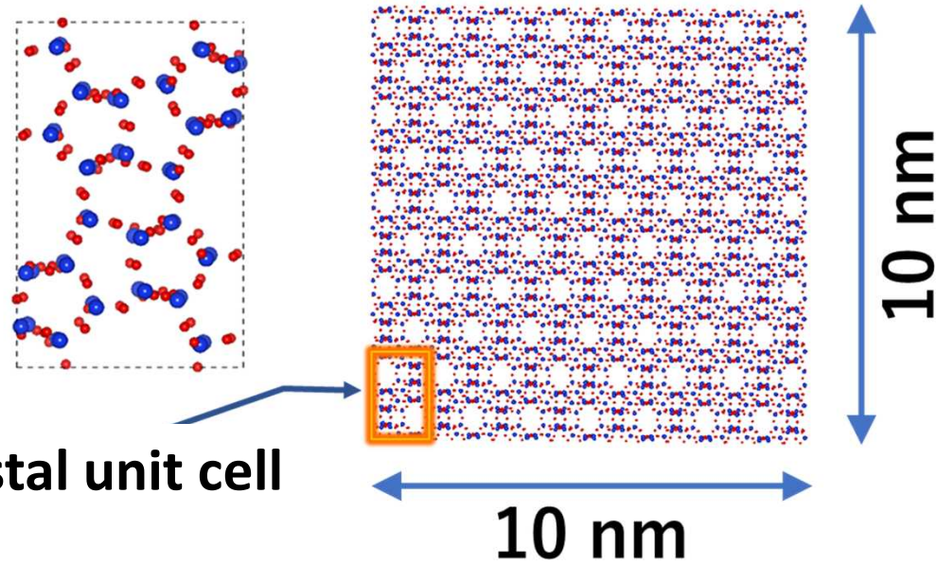
Atomic resolution images of K-CHA and Cu-CHA by TEM

Successful observation of K ions in K-CHA

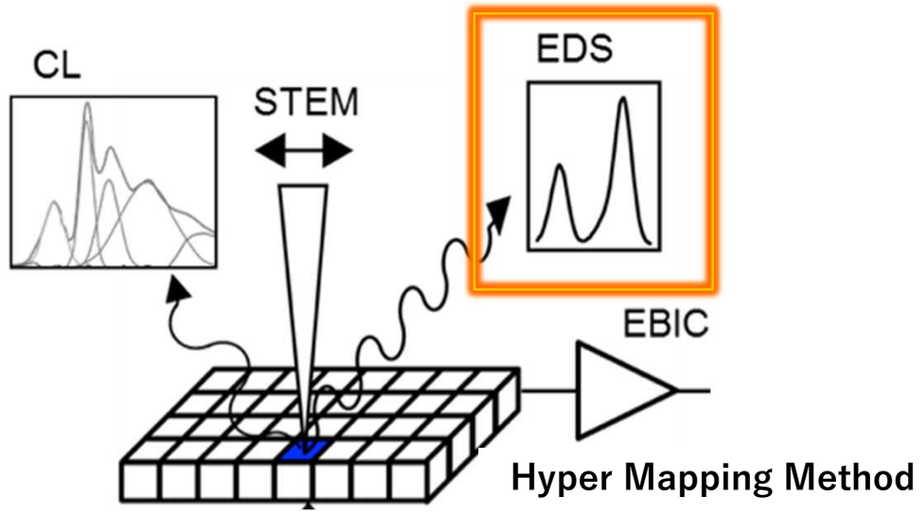
The observation result of Cu-Cha is under consideration.

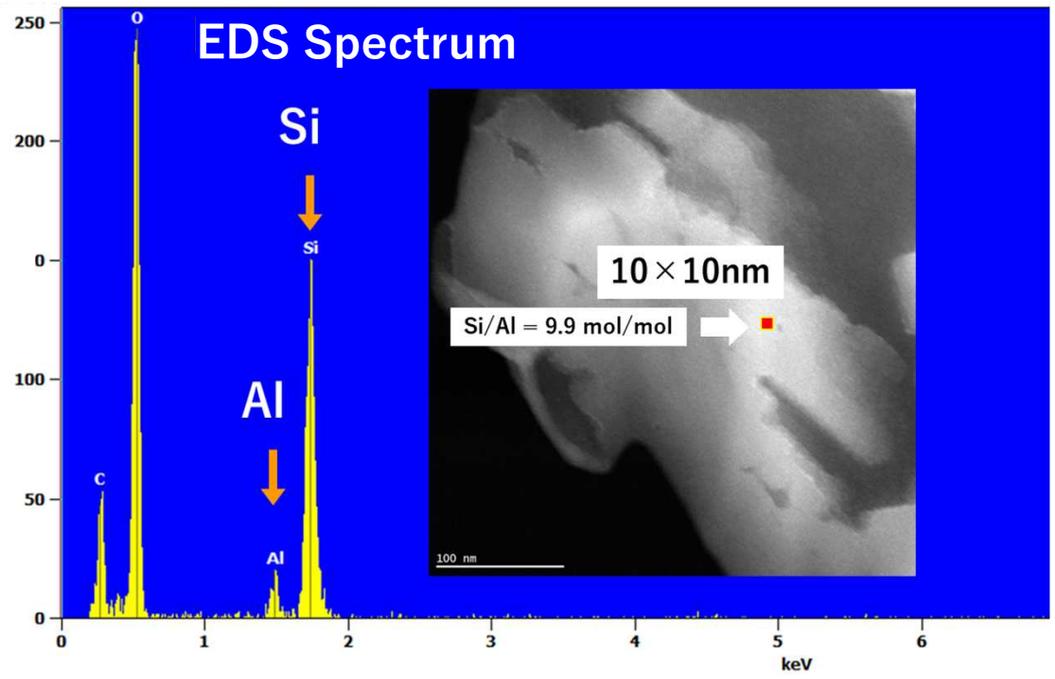
2） chemical composition analysis using TEM-EDS method（quantitative analysis）

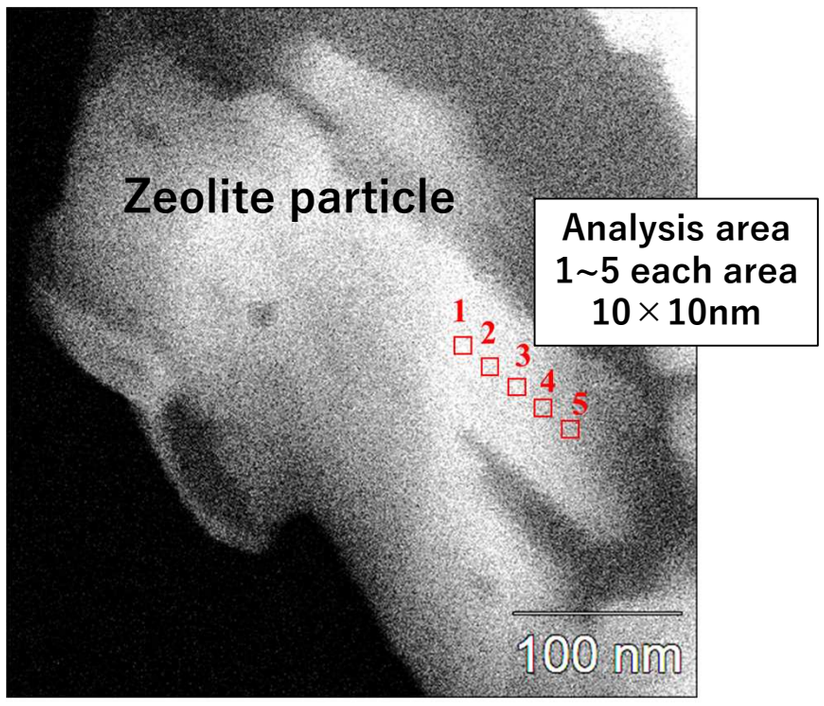
Establishment of measurement conditions for the determination of chemical composition ratios in the 10 x 10 nm region



Atomic structure of zeolite crystal（MFI） （10×10nm）







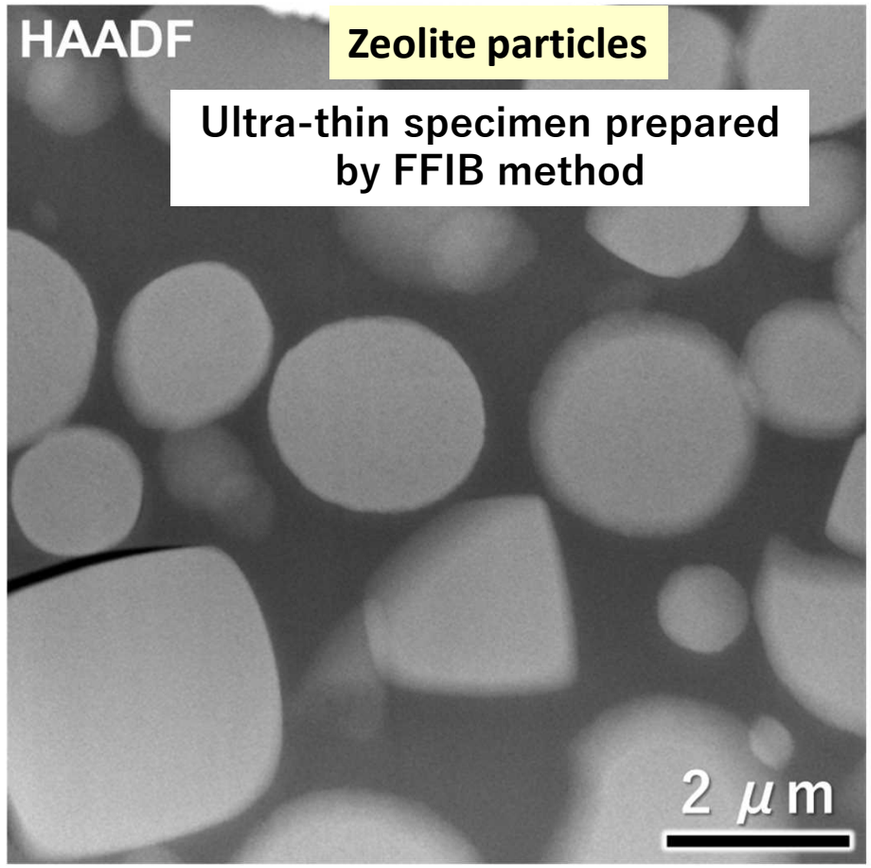
- Analysis area: approx. 400X400 nm
- Analysis pixel size: 1.56 nm

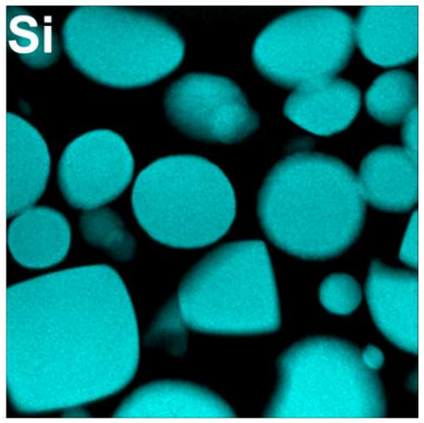
Quantitative measurement results for each region

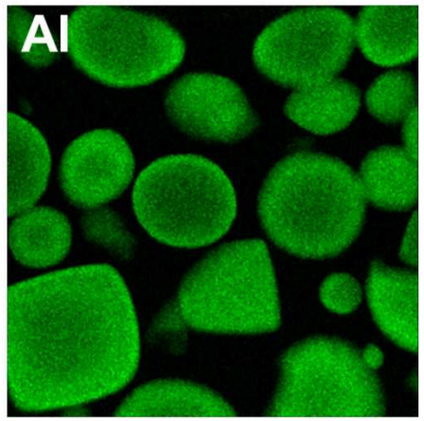
Area	Concentration (at.%)						Si/Al
	C-K	O-K	Al-K	Si-K	Ti-K	Total	
1	28.76	62.54	0.97	7.72	0.00	100.00	8.0
2	30.29	60.91	0.81	7.98	0.00	100.00	9.9
3	30.54	61.35	0.77	7.34	0.00	100.00	9.5
4	34.09	58.60	0.69	6.60	0.02	100.00	9.6
5	37.51	56.68	0.43	5.36	0.01	100.00	12.5

2） chemical composition analysis using TEM-EDS method (mapping and qualitative analysis)

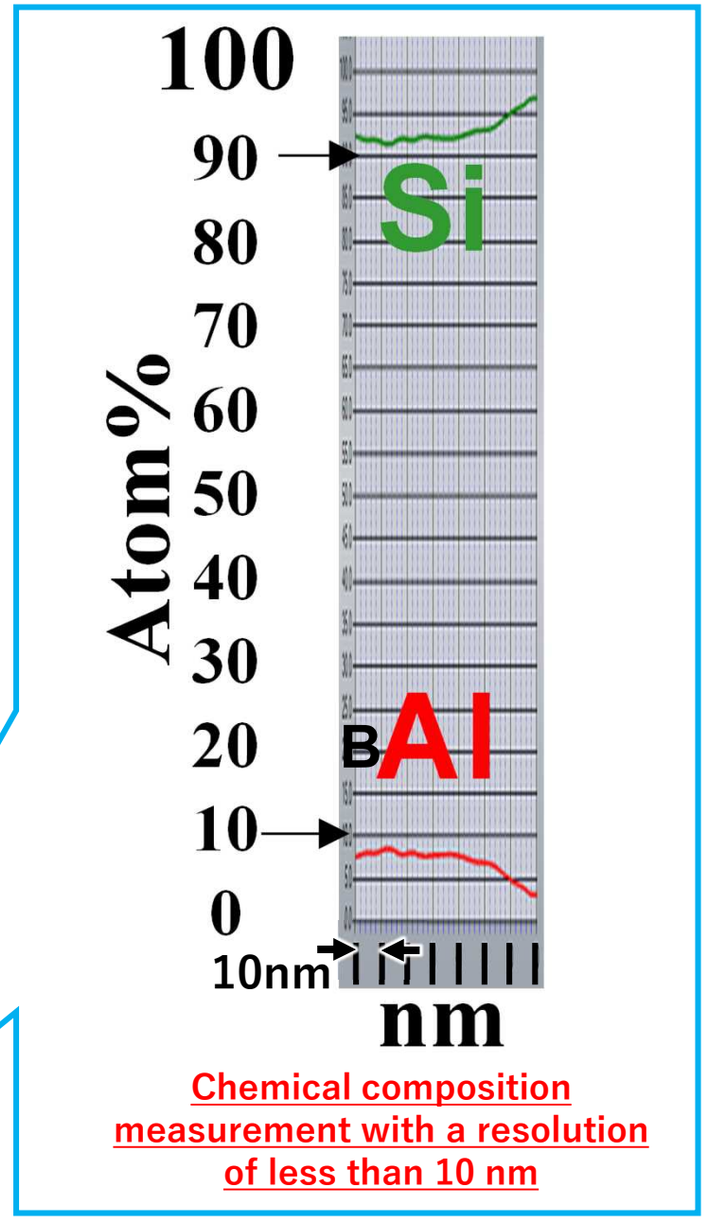
Establishment of chemical composition mapping conditions for single nm region



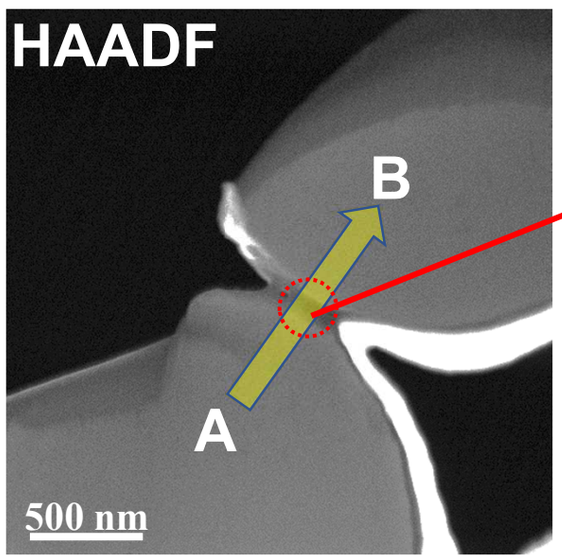


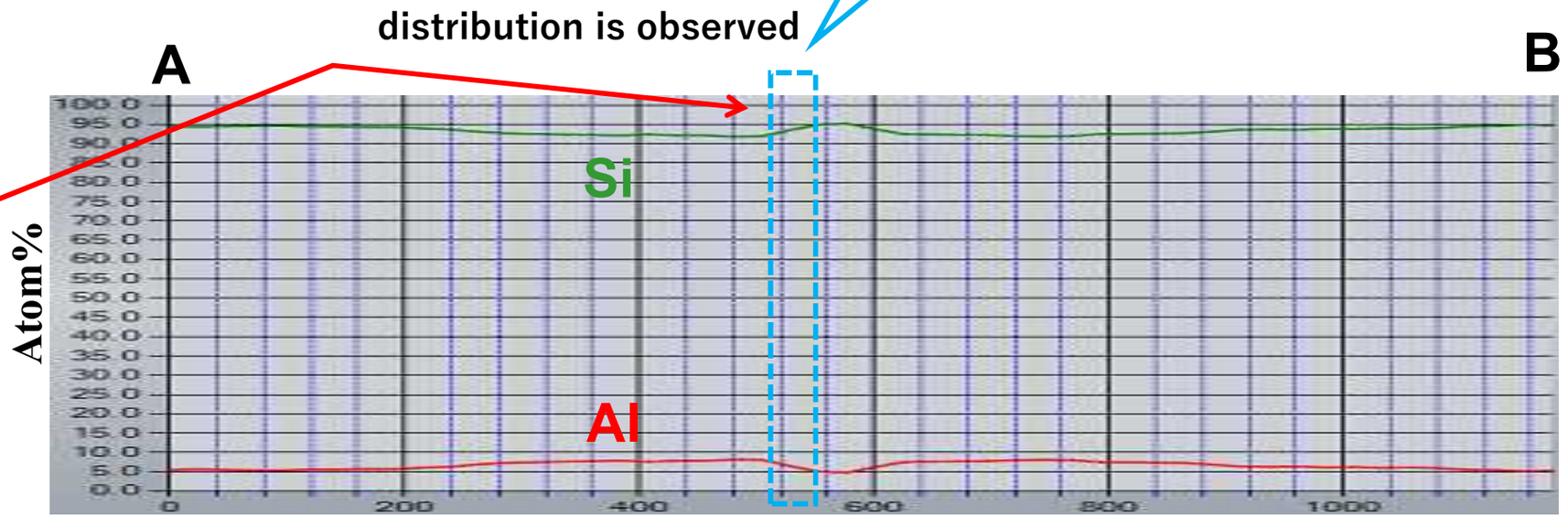


Al concentration distribution is observed



Chemical composition measurement with a resolution of less than 10 nm





MOONSHOT
RESEARCH & DEVELOPMENT PROGRAM