

## Supplementary Information

### Proton conduction in $A^{III}_{0.5}B^V_{0.5}P_2O_7$ at intermediate temperatures

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Table S1. Crystalline phases of compounds comprised of the other A elements

A	B	Crystalline phase
Al	Sb	unindexed
Ga	Sb	unindexed
Y	Sb	$\text{Sb}_2(\text{P}_2\text{O}_7)_2$
Bi	Sb	$\text{BiPO}_4, \text{Sb}_2(\text{P}_2\text{O}_7)_2$
La	Nb	$\text{La}_7\text{P}_3\text{O}_{18}, \text{Nb}_2\text{O}_5, \text{Nb}_5\text{P}_7\text{O}_{30}$
Nd	Nb	$\text{Nd}_5\text{P}_5\text{O}_{14}, \text{Nb}_2\text{O}_5, \text{Nb}_5\text{P}_7\text{O}_{30}$
Sm	Nb	$\text{Sm}_5\text{P}_9\text{O}_{30}, \text{Nb}_2\text{O}_5, \text{Nb}_5\text{P}_7\text{O}_{30}$
In	Ta	$\text{In}_2\text{O}_3, \text{In}(\text{PO}_3)_3, \text{Ta}_2\text{PO}_5$
Sb	Ta	$\text{Ta}_2\text{PO}_5$
La	Ta	$\text{LaP}_5\text{O}_{14}, \text{Ta}_2\text{PO}_5$

Figure S1(a): XRD pattern of  $\text{Fe}_{0.5-x}\text{Nb}_{0.5}\text{P}_2\text{O}_7$

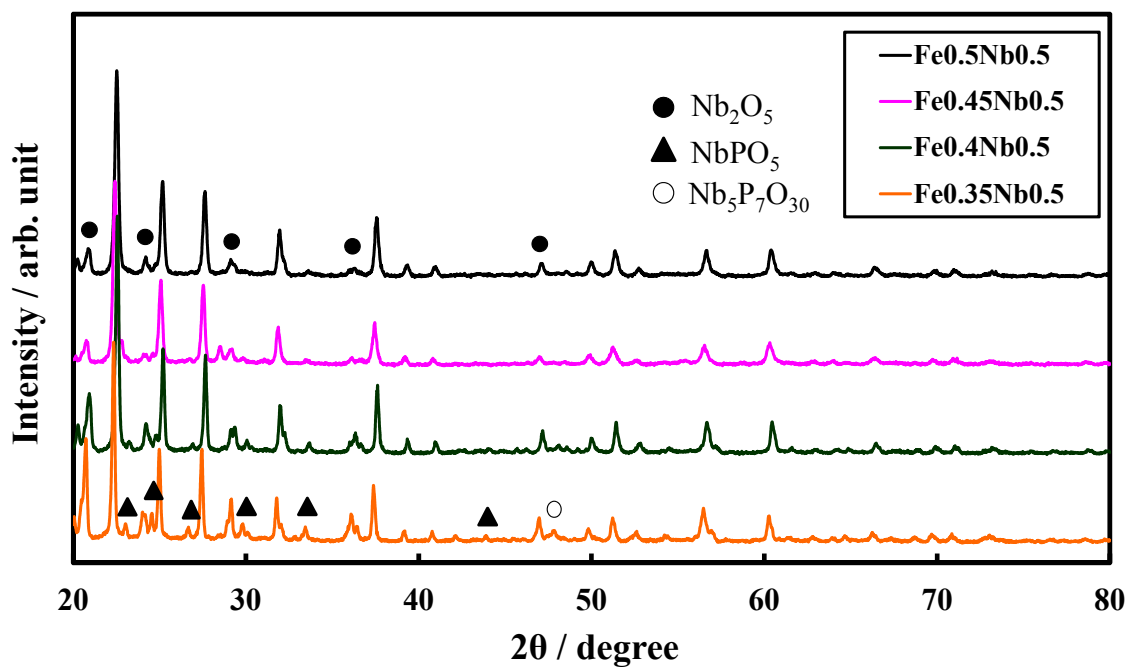


Figure S1(b): XRD pattern of  $\text{Fe}_{0.5}\text{Nb}_{0.5-x}\text{P}_2\text{O}_7$

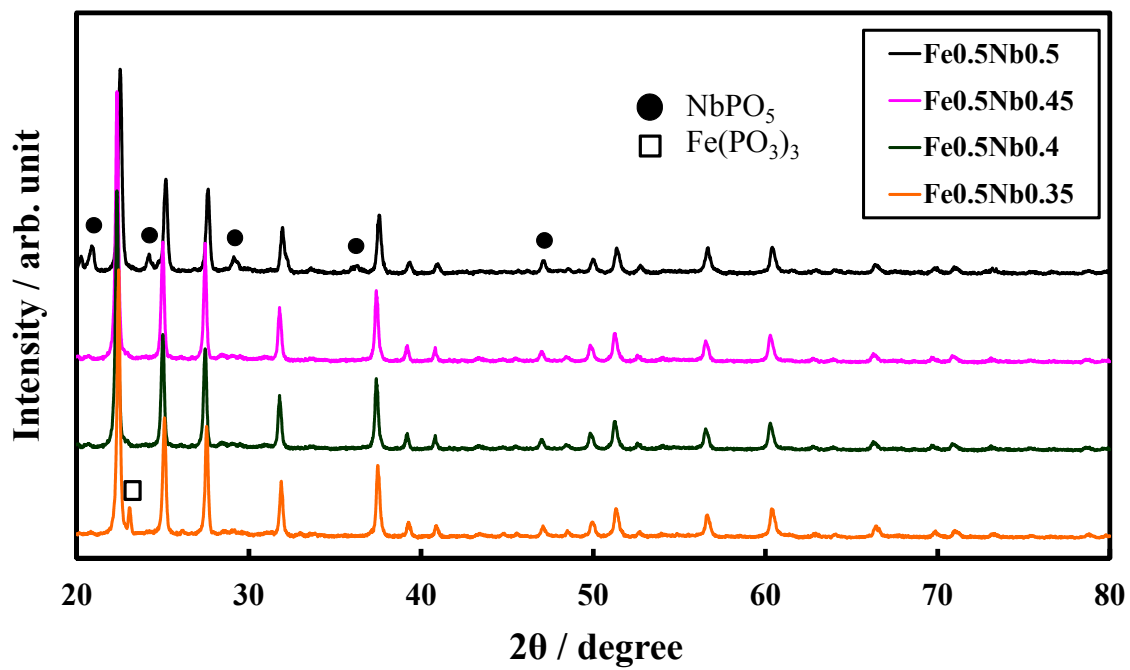


Figure S1(c): XRD pattern of  $\text{Fe}_{0.5-x}\text{Ta}_{0.5}\text{P}_2\text{O}_7$

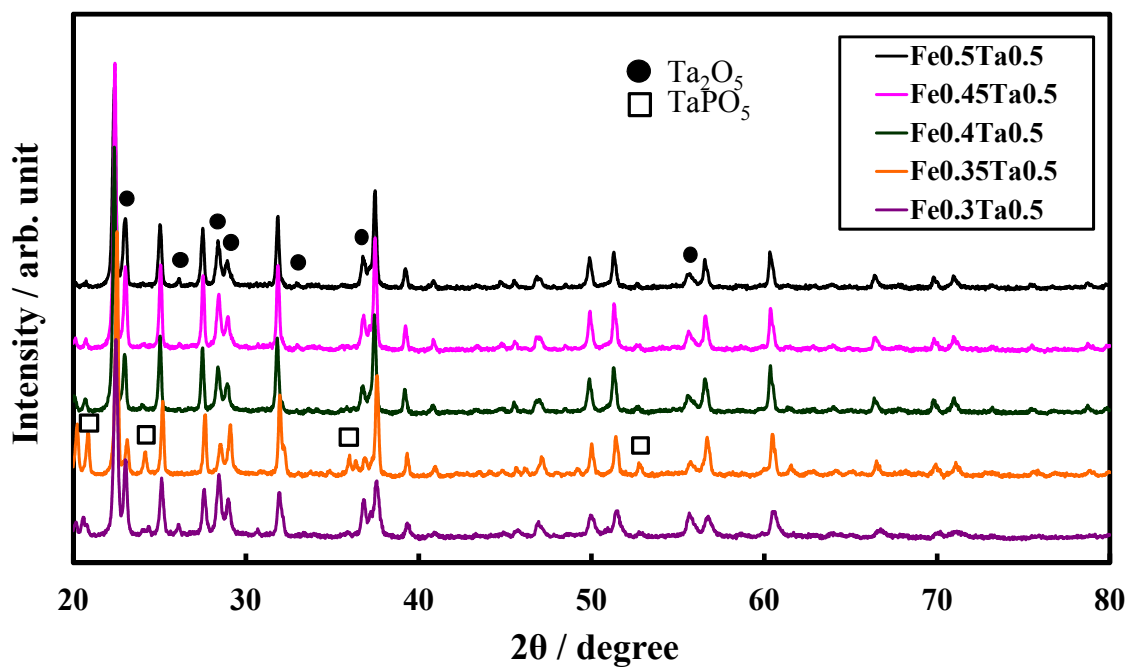
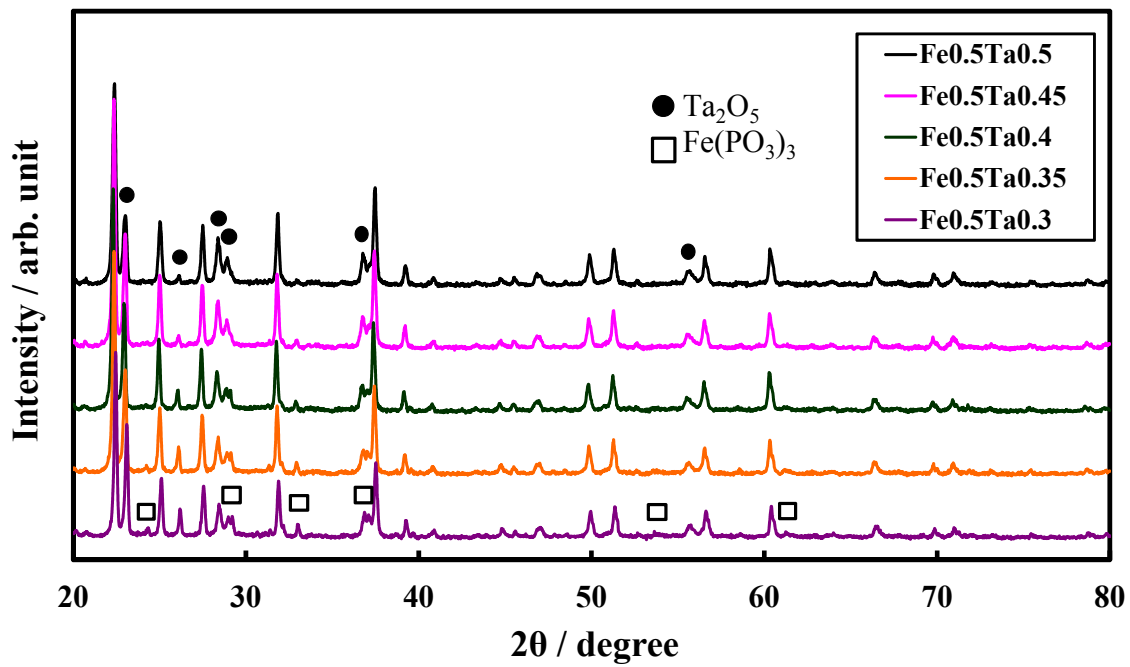


Figure S1(d): XRD pattern of  $\text{Fe}_{0.5}\text{Ta}_{0.5-x}\text{P}_2\text{O}_7$



**Figure S2:**  $^{31}\text{P}$  MAS NMR spectrum of  $\text{Fe}_{0.35}\text{Nb}_{0.5}\text{P}_2\text{O}_7$

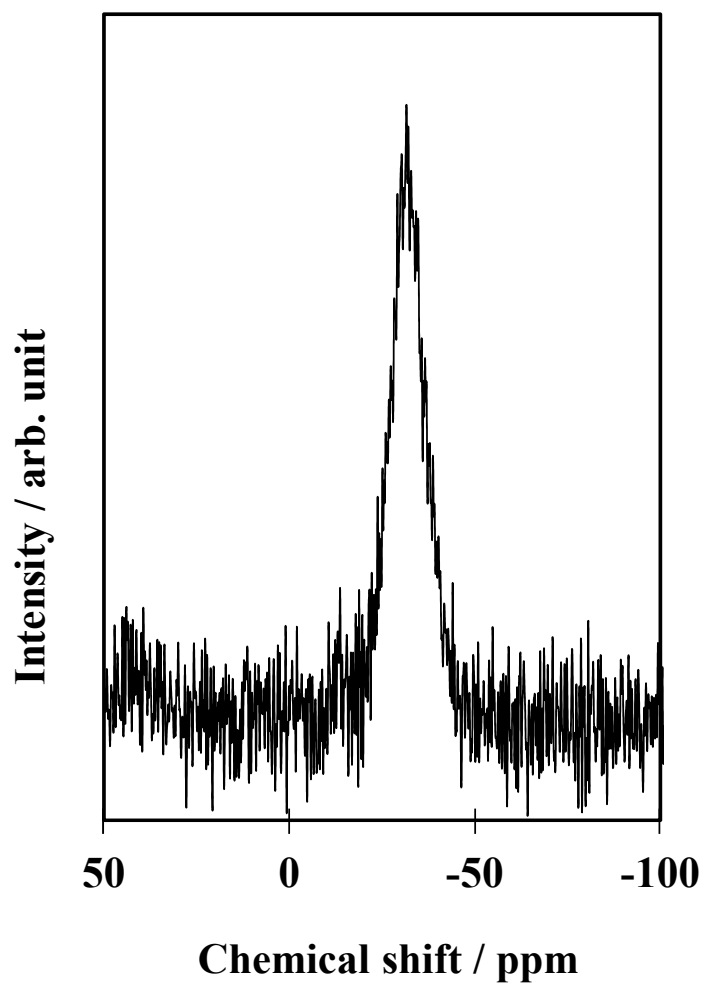


Figure S3(a): Electrical conductivity of  $\text{In}_{0.5}\text{Sb}_{0.5-x}\text{P}_2\text{O}_7$

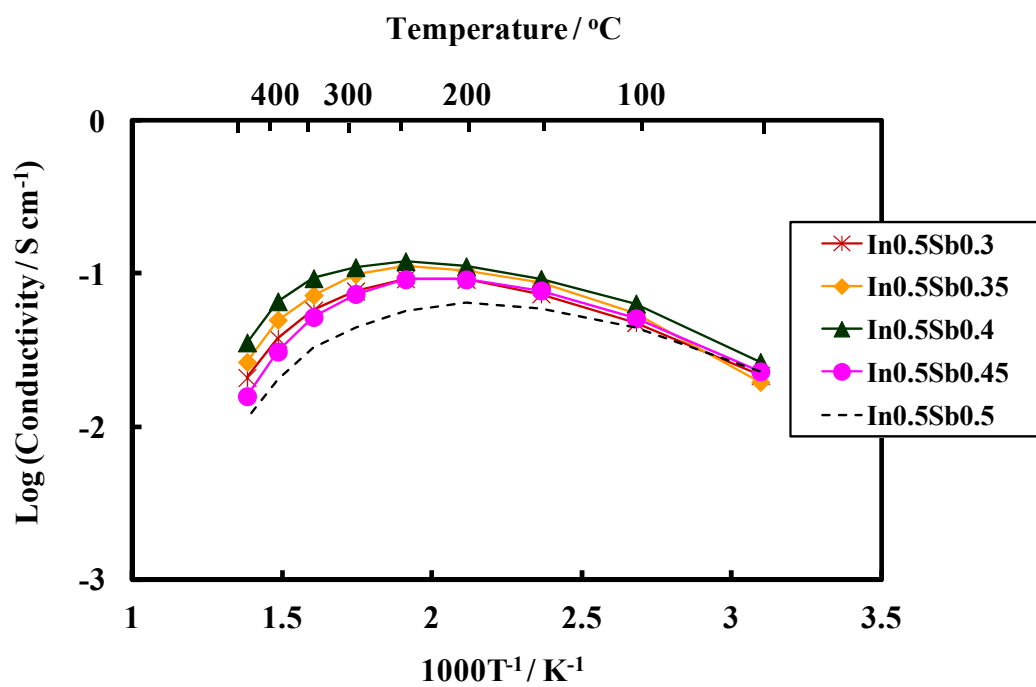




Figure S3(b): Electrical conductivity of  $\text{Fe}_{0.5}\text{Nb}_{0.5-x}\text{P}_2\text{O}_7$

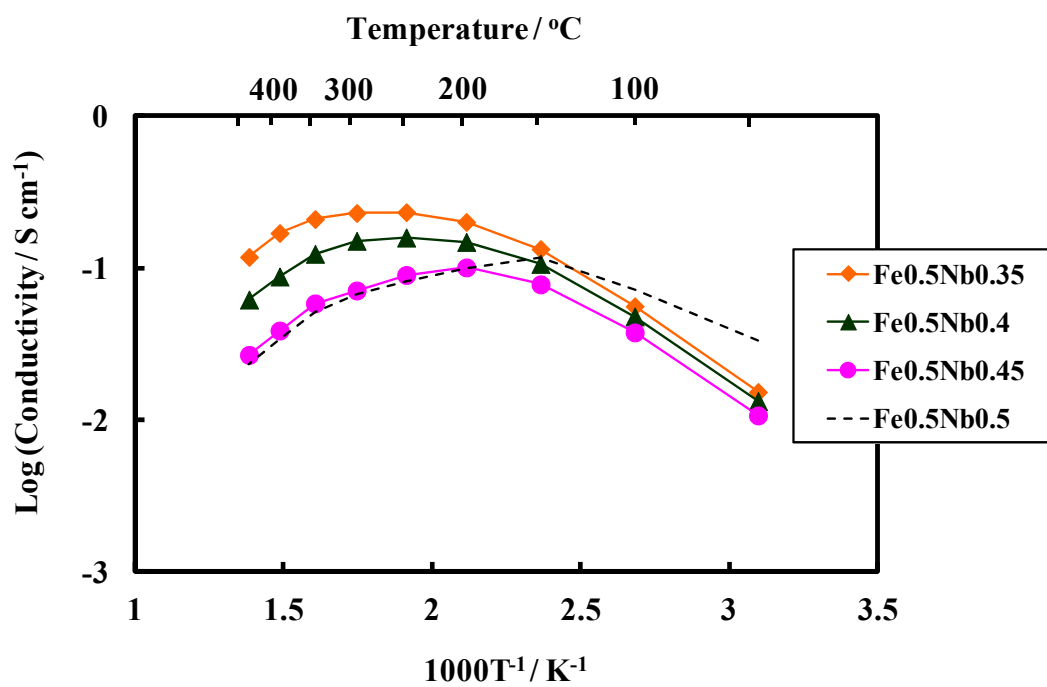


Figure S3(c): Electrical conductivity of  $\text{Fe}_{0.5}\text{Ta}_{0.5-x}\text{P}_2\text{O}_7$

