

Microwave irradiation suppresses Jahn-Teller lattice distortion in spinel LiMn_2O_4 cathode material for lithium-ion batteries

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Introduction

Jahn-Teller (J-T) distortion is the key challenge to the realizing of the full electrochemistry potential of the commercialized LiMn_2O_4 (**LMO**) cathode material for lithium-ion batteries (LIBs). This novel work explored the use of efficient synthesis method that requires low energy without the use of toxic reagents and organic solvents (sustainable chemistry principles). The innovative technology of microwave irradiation suppressed the limiting J-T distortion in commercialized LMO and improve the electrochemistry. This is a simple, low-cost and environmentally benign scale-up modification process for LMO and related cathode materials for the development of high-performance LIBs.

LiMn_2O_4

Advantages

- ❖ Safe
- ❖ High voltage
- ❖ Low cost
- ❖ Less toxic



Causes of capacity decay

1. The presence Jahn-Teller (J-T) active Mn^{3+}
2. The charge disproportionation of Mn^{3+}

Conventional Strategy

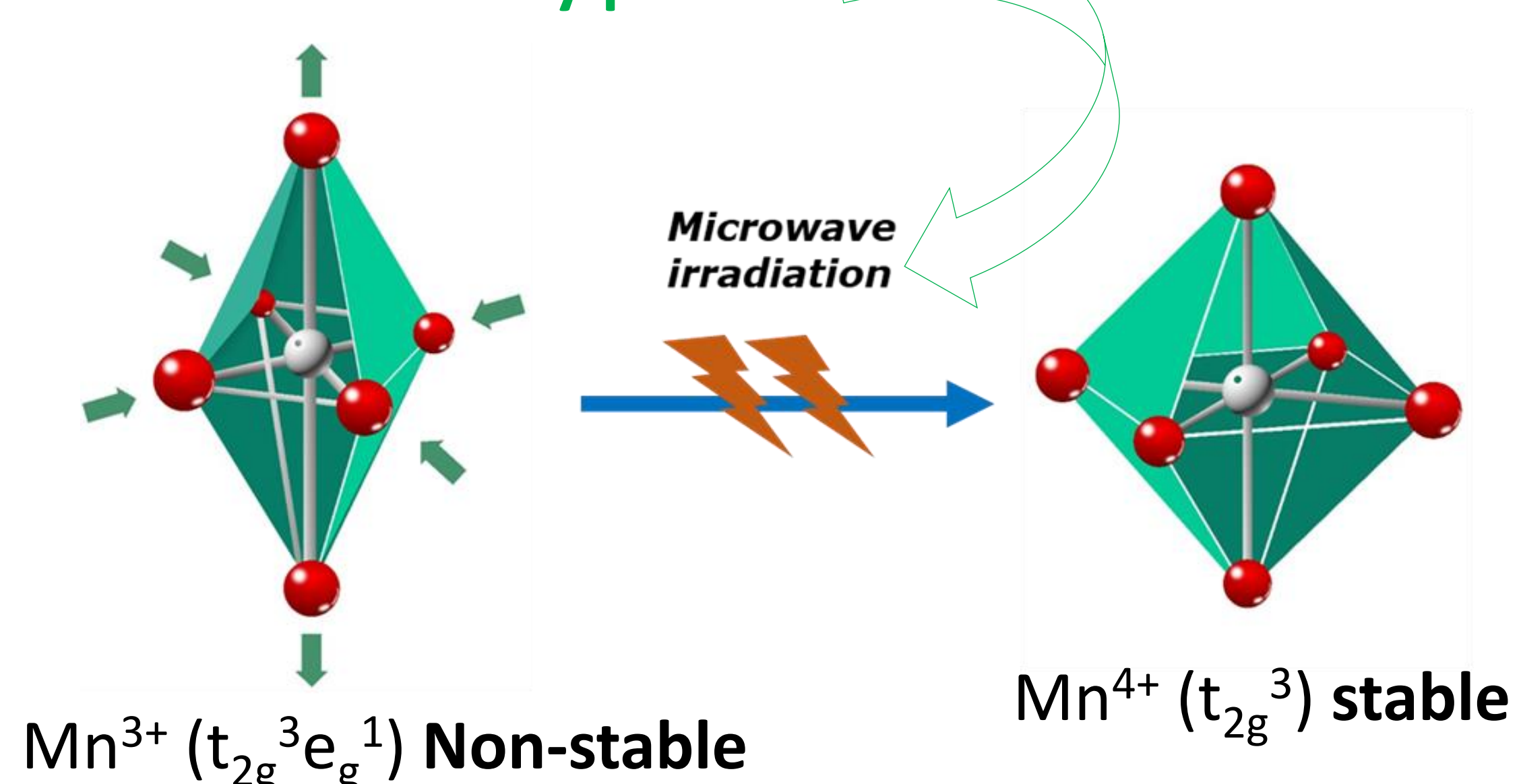
1. Cation doping ($\text{LiM}_y\text{Mn}_{2-y}\text{O}_4$)
2. Surface coating

Disadvantages

1. Loss in the specific capacity of the LMO cells.
2. Dopants increase the cost of materials.

This research strategy

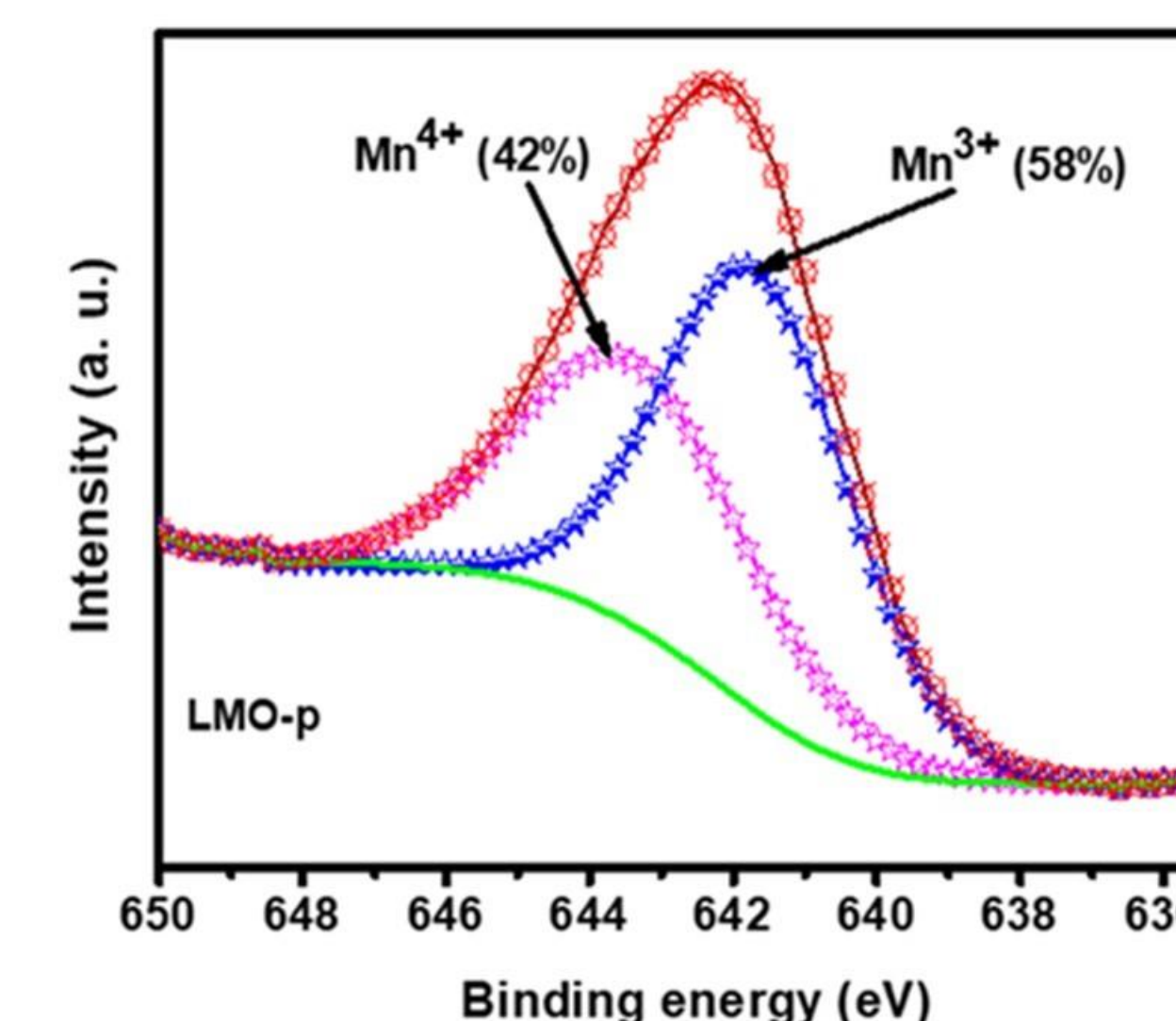
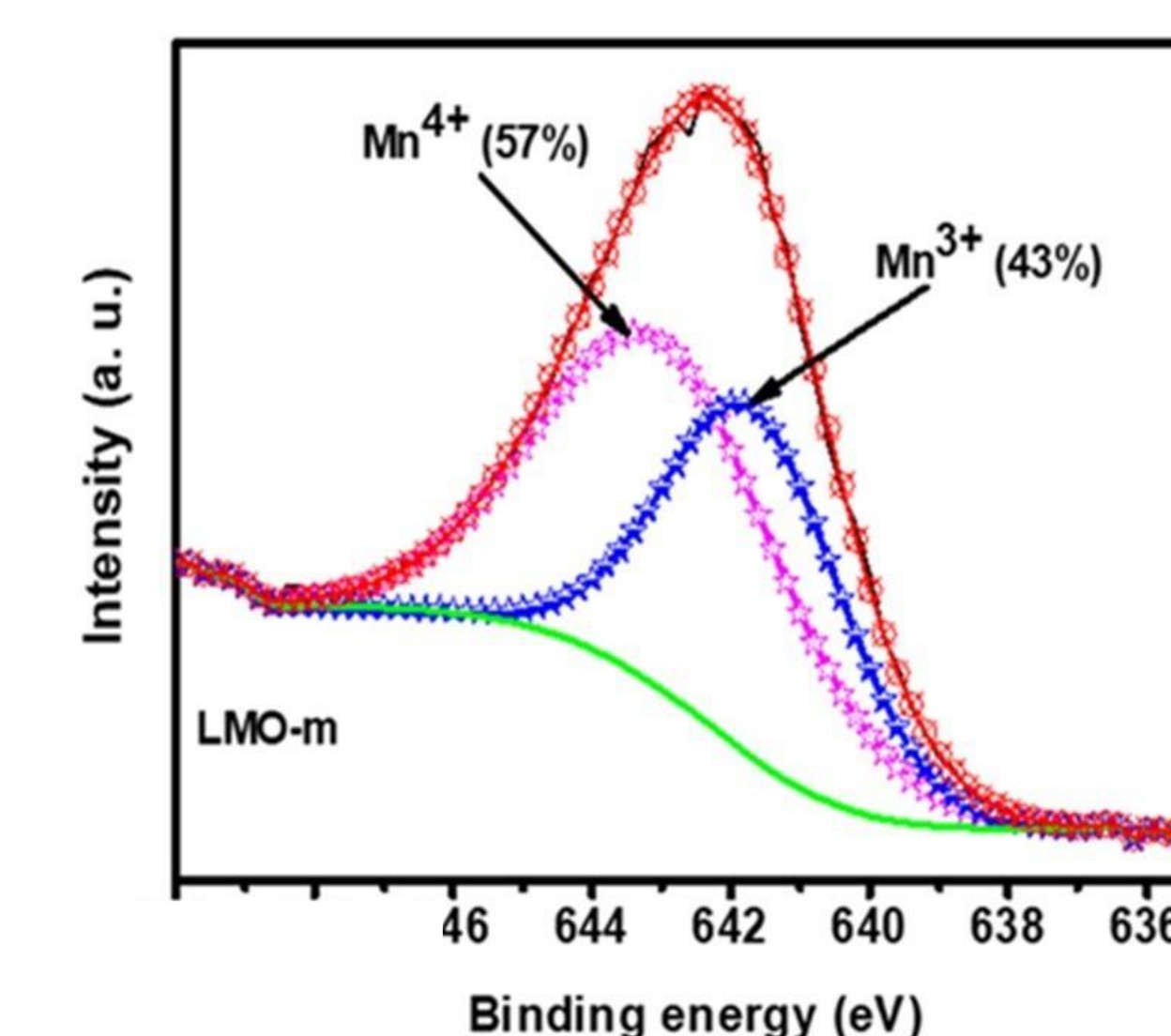
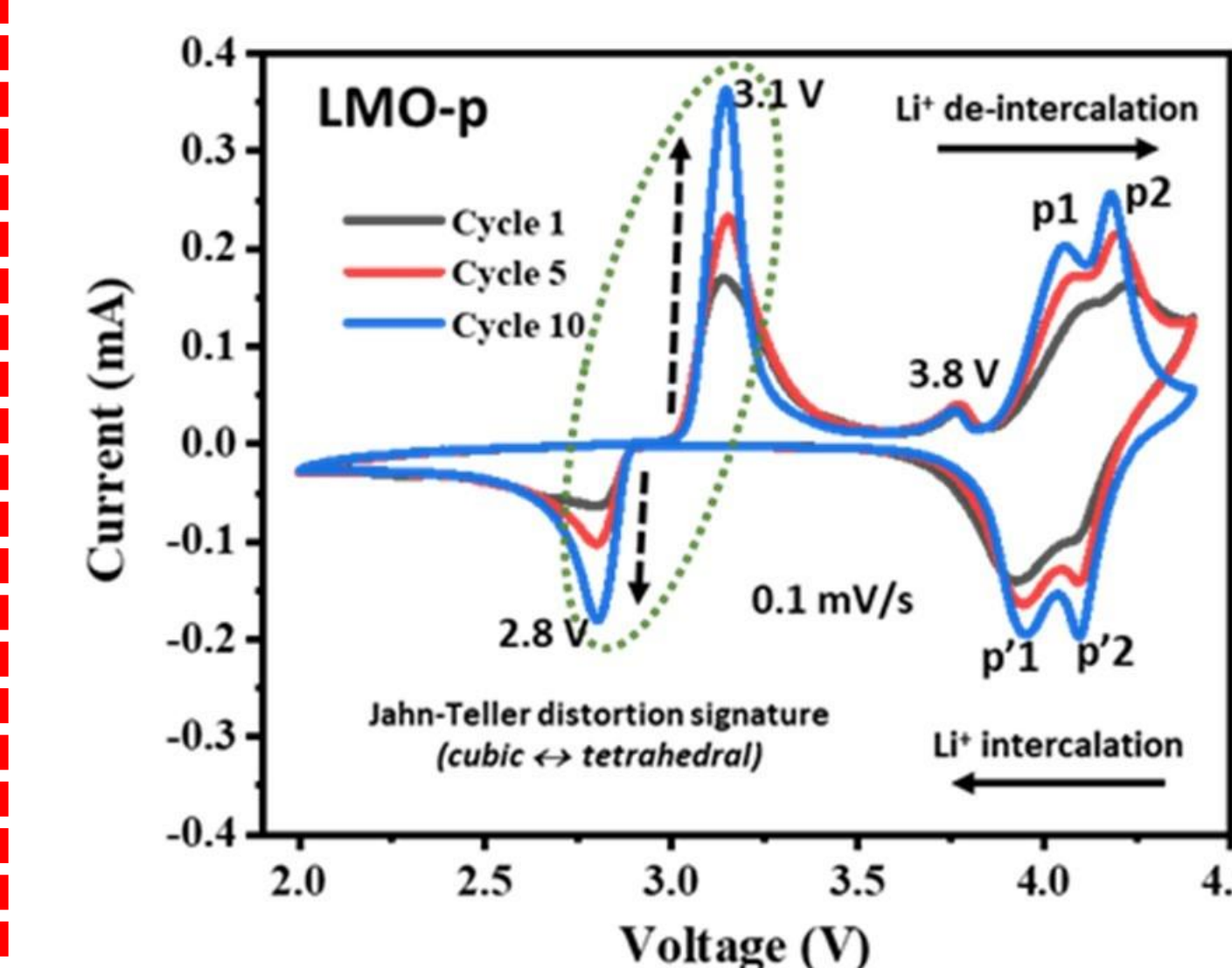
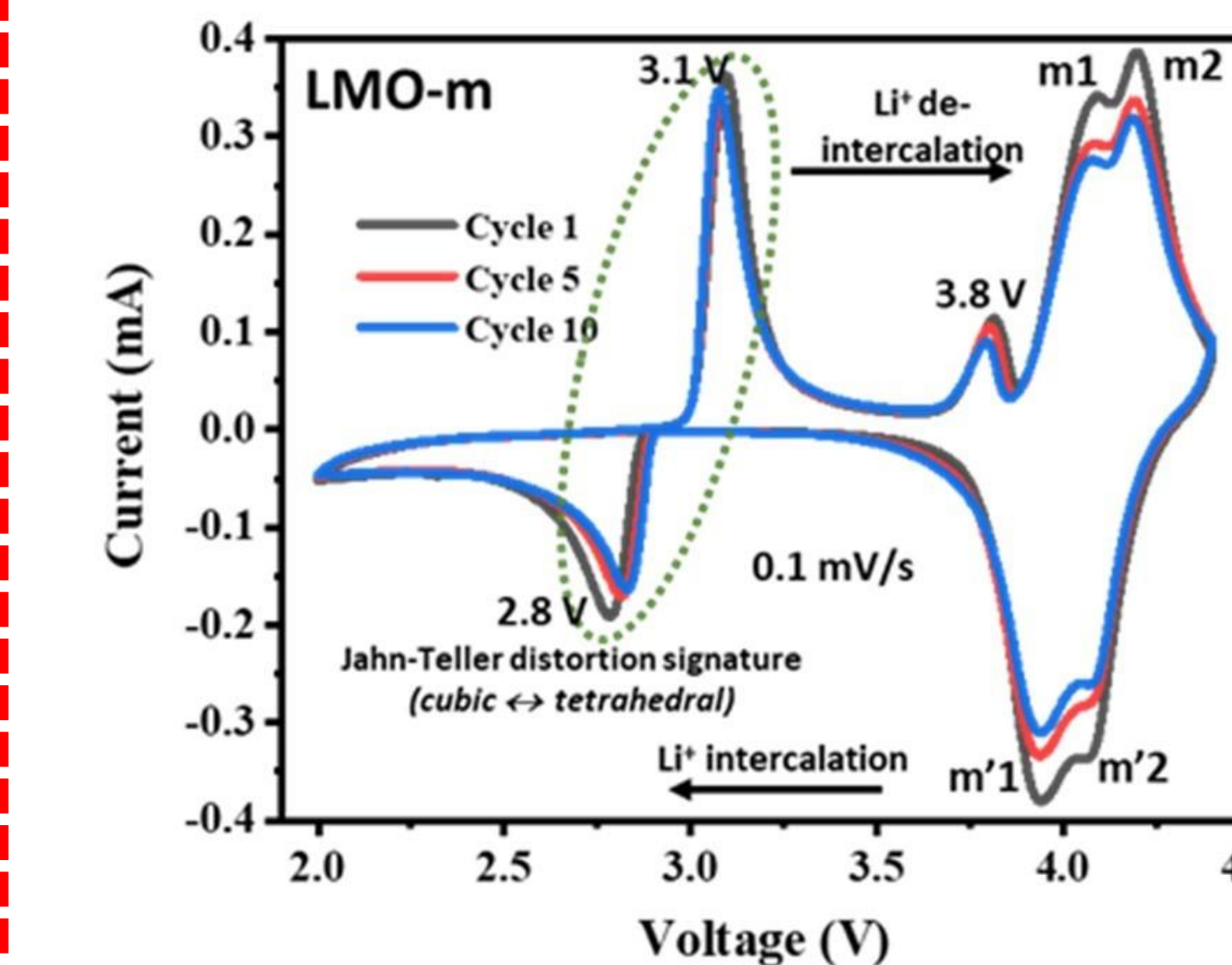
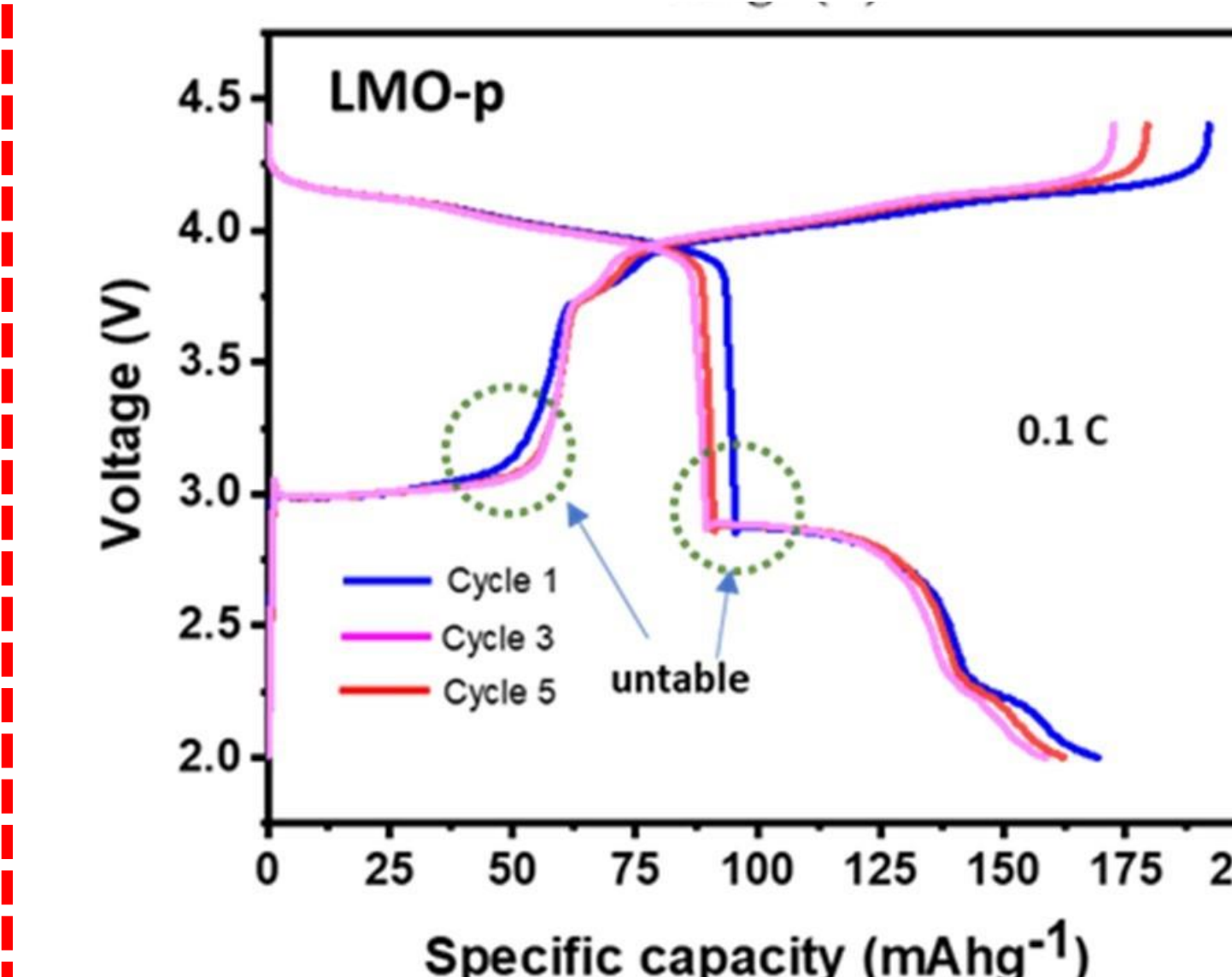
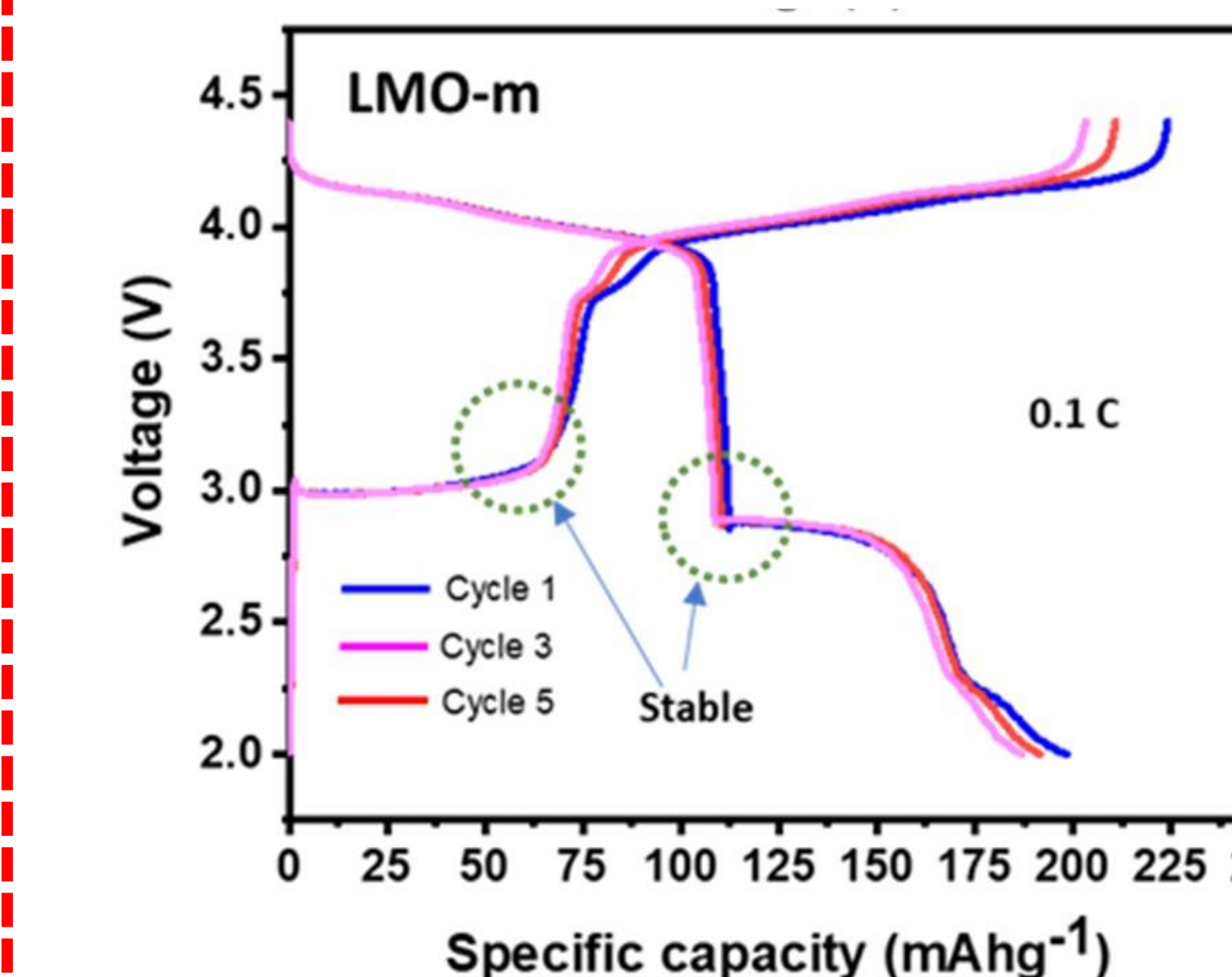
Green chemistry process



Advantages

- ❖ Energy saving
- ❖ Time saving
- ❖ No doping
- ❖ No surface coating
- ❖ Reduced cost
- ❖ Environmentally friendlier

Results



Conclusion:

The microwave irradiation has been used as a strategy to

- increase the ratio $r = [\text{Mn}^{4+}]/[\text{Mn}^{3+}]$
- increase the average Mn oxidation state
- **suppressed Jahn Teller distortion**
- Increase the specific capacity LMO electrode for Li-ion battery without the use of toxic reagents and organic solvents

