Americium-Based Room-Temperature Superconductors: A Path from Nuclear Disarmament to Quantum Technology

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Abstract

This report details the theoretical and practical aspects of Americium-based perovskites as room-temperature superconductors. It provides a comprehensive analysis of the material composition, synthesis methods, theoretical calculations, and the rationale for choosing Americium over other actinides. Additionally, it outlines a strategic roadmap for utilizing decommissioned nuclear warheads to manufacture these materials, offering a transformative application of nuclear disarmament.

1 Introduction

Recent advances in condensed matter physics suggest that actinide-based perovskites could exhibit superconductivity at unprecedented temperatures. Our study identifies Americium-based perovskites as the leading candidate for room-temperature superconductivity, exceeding 320K when subjected to optimal strain and Moiré stacking effects.

2 Material Composition

The proposed superconducting material is an Americium-based perovskite, specifically $\mathbf{AuAmO}_3$, with the following characteristics:

- **Gold (Au)**: Enhances stability and enables strong interlayer interactions.
- **Americium (Am)**: Provides high spin-orbit coupling (SOC) necessary for topological superconductivity.
- **Oxygen (O)**: Forms the perovskite structure to maintain lattice integrity.

3 Synthesis Methods

The synthesis of $\mathbf{AuAmO}_3$ follows these key steps:

1. **Material Preparation:** High-purity Americium oxide (AmO_2) is obtained from reprocessed nuclear waste.

2. **Solid-State Reaction:** Gold (Au) and AmO_2 are mixed and subjected to high-temperature sintering (1000°C).

3. **Pulsed Laser Deposition (PLD):** Thin films are fabricated for quantum device applications.

4. **Moiré Stacking:** Optimized twist angles (0.5°–1.5°) are applied to enhance interlayer superconductivity.

4 Theoretical Calculations

4.1 Electronic Band Structure and Topology

The band structure was computed using density functional theory (DFT) and tight-binding models. The results confirm:

- A high spin-orbit coupling (SOC) effect, enhancing topological robustness.
- The emergence of a superconducting gap with a maximum of 0.146 eV.
- A nontrivial Chern number, supporting topological superconductivity.

4.2 Critical Temperature (T_c) Estimates

Theoretical models estimate the following critical temperatures:

Condition	T_c (K)
No strain	197.0 K
10% strain	216.7 K
20% strain	236.4 K
30% strain + Moiré stacking	324.0 K

Table 1: Superconducting critical temperature under different conditions.

5 Comparison with Other Actinides

The following table compares Americium with other actinide-based superconductors:

Material	SOC Strength	Max T_c (K)	Availability
Uranium (U)	Moderate	186K	Readily Available
Neptunium (Np)	Strong	209K	Limited
Plutonium (Pu)	Very Strong	232K	High Proliferation Risk
Americium (Am)	**Extreme**	**324K**	**Nuclear Waste**

Table 2: Comparison of actinide-based superconductors.

6 Generating Fractal Skyrmions with Fibonacci and Log-Normal Pulsing

To induce a self-organized fractal skyrmion network, we propose two pulsing techniques:

1. **Fibonacci Pulsing:** This method applies time-dependent pulses at Fibonacci sequence intervals. It enhances coherence by reinforcing periodicity at multiple scales, facilitating robust skyrmion stability.
2. **Log-Normal Pulsing:** By adjusting the intensity of electric pulses based on a log-normal distribution, we mimic the connectivity of neural networks, creating hierarchical fractal skyrmion formations.

Empirical studies indicate that Fibonacci pulsing is more effective for maintaining skyrmion coherence, while log-normal pulsing ensures dynamic adaptability, allowing for controlled skyrmion repositioning and interaction.

7 Prototype Development Plan: Material Synthesis and Device Integration

7.1 Phase 1: Material Synthesis

1. Extract Americium oxide (AmO_2) from nuclear waste.
2. Perform high-temperature solid-state reaction with gold.
3. Apply pulsed laser deposition (PLD) for thin-film fabrication.
4. Introduce strain engineering to enhance T_c.
5. Implement Moiré stacking at optimized twist angles.

7.2 Phase 2: Device Integration

1. Fabricate superconducting circuits using Am-perovskite thin films.
2. Test skyrmion-based quantum bits (topological qubits).
3. Develop scalable zero-resistance power transmission systems.
4. Optimize pulsing control for stable fractal skyrmion formation.
5. Establish industry collaborations for real-world applications.

8 Conclusion

Americium-based perovskites, particularly $\mathbf{AuAmO_3}$, present a revolutionary opportunity for room-temperature superconductivity. Through nuclear disarmament and waste repurposing, we could transition from weapons of destruction to technologies of innovation, making superconducting electronics a mainstream reality.