COMMUNICATION BETWEEN CHINESE AND NON-CHINESE SCIENTISTS IN THE DISCOVERY OF HIGH-Tc SUPERCONDUCTOR:
I. THE FORMAL PERSPECTIVE

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As the first part of a two-phase study, 240 documents highly cited in a self-created Chinese database and in Science Citation Index for the period of 1987-89 were examined to delineate the formal structure of communication in superconductivity research. Noteworthy similarities, e.g., analogous cited cores, identical publication sources, and comparable intellectual structures of cocitation data, were found in formal communication between Chinese and non-Chinese scientists. However, differences were also located in citedness, timeliness, and direction of communication.

Introduction

From late 1986 to early 1987, the physics community in the world was overwhelmed with excitement, which was triggered by the discovery of high temperature superconductors. The discovery, among other things, astonished the world with the potential applications of the high-Tc superconductors and the rapidity of the Nobel Prize awarded to the discoverers. In addition, the discovery surprised those who were interested and involved in the state of science in China. "Big science" is generally conducted in developed countries. How could China, as a developing country, played a leading role in the discovery?

This question can be looked at from various perspectives since advances and technology, such as the discovery of high-Tc superconductors, are determined by many factors. Scientific communication is one of them. Hence the present writer intends to study China's contribution to the discovery of high-Tc superconductivity from the viewpoint of communication. The research was conducted in the phases:

(1) To identify similarities and differences in formal communication between Chinese and non-Chinese superconductivity researchers during the discovery.
(2) To investigate the existence and extent of informal communication in the field behind the formal domain.

The first phase of the study will be reported in the current paper. Activities of informal communication among superconductivity researchers is to be described in another article.2

According to Garvery and Griffith,3 "Formal channels (of communication) carry information which is public and remains in permanent storage, informal channels carry information to restricted audience and its storage is relatively temporary". The most common medium for storing formal information is scientific journal. The informal channels often used in professional communication include talking face-to-face, contacting by phone, and exchanging preprints/data.

**Related works**

Formal communication activities are commonly explored by analyzing publication patterns and citation patterns of scientists.4 There are many such studies on developed nation sciences. In contrast, researches of similar type for scientists in developed countries are much less in quantity, and did not emerge until early 1980's. In those studies, people surveyed where Third World scientists published their research results, and only found that most of them published in local journals and few contributions to local journals were from foreign sources.4-8 As for citation patterns in developing countries, "little consumption" seems to be the research outcome, which means publications of scientists in developing countries were rarely used by colleagues at home and abroad.5,6,8,9 Furthermore, the direction of formal communication appears one-way, implying that scientists from developing countries cited colleagues in developed nations most of time, while the reverse does not hold true.4,5,9,10,11

As many other specialties, the development of superconductivity research attracted the attention of researchers in scientometrics. Early events were studied by Nadel who did his doctoral thesis on superconductivity. He used citation and cocitation data together with an intellectual history to "observe the development of the physics of superconductivity from 1930-1964".13 With citing papers, cited papers, and cognitively important (highly cited) papers as data source for another study, Nadel found support evidences to the institutional hypothesis of initial dispersion and later concentration of publications in the field of superconductivity for the time range of 1911-1964.14 Arunachalam and Singh15 examined the publication and citation...