

Commentary

Thermal Spray: Preserving 100 Years Of Technology

Why Choose 2006 As The First 100 Years?

The Schoop Patent that concerns the origins of thermal spray (TS) can be traced back to 1912 (for example: “Metal Plating with the Air Brush,” *Scientific American*, Vol 1, 1913, p 346). A tradition exists where chronological anniversaries are recognized by an appropriate public observance. Such an observance recognizes an important historical event and allows a retrospective account of that event. In many instances no specific date is selected, but rather a time frame that may span several days, a few months, or an entire year, since the magnitude of the event is such that its anniversary needs to be placed into the context of its evolution.

The observance of the first 100 years of thermal spray falls under a very broad time frame because the early history of this technology is clouded by lack of referred documentation. The early practitioners and inventors of thermal spray were probably unaware that their efforts would spawn multimillion dollar industries across many technological sectors. It is probably safe to assume that these early workers were more interested in preserving jobs rather than history. As well, a certain amount of secrecy would have given these early technologists a commercial edge.

It is certainly reasonable to question why the year 2006 could be selected as the first century of TS, and the following arguments are posed to justify this assertion. It is documented that Schoop (the proclaimed “father of TS” according to the book by Ballard) was publishing on that topic in 1910. It is fair to comment that the precursor work that led to this patent commenced from 6 to 10 years before being issued. Thus, it is suggested that Schoop was working on the ideas and concepts associated with TS in about 1906. Regardless of the exact date and timing of Schoop’s efforts, there is a convincing argument that the time frame of 2006-2010 can be declared as the period during which “The First Century of Thermal Spray” can be celebrated.

It can be further noted that an 1882 German Patent (number 24,460) illustrates the elementary principles of thermal spray

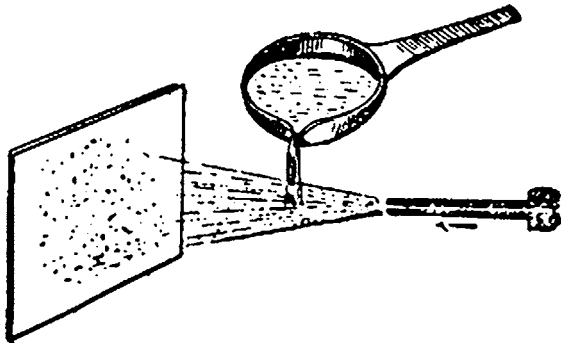


Fig. 1 The basic principles of thermal spray. Taken from Ref 1, p 1 and, in turn, attributed to an 1882 German patent



Christopher C. Berndt



Ghislain Montavon

(Fig. 1). Therefore, the statement concerning “The First Century of Thermal Spray,” although used with some reserve and caution, is an appropriate date that can serve the purpose of promoting thermal spray within a global context.

Time Capsules: Their Meaning and Purpose

The First Century of Thermal Spray is an important historical event that is worthy of recognition. For example, this present document is a vehicle that intends to promote discussion concerning a long-term plan for recording important historical events that relate directly to TS. Another aspect of this effort is that such an introspective account can lead to a prospective foretelling of future events; that is, there is the opportunity for an analysis of important future events that will steer TS in the near (10 to 15 years in the future) and long (more than 20 years) terms.

The discussion concerning “time capsules” is important because it helps formulation of a course of action that not only recognizes the past, but can be used to promote technology. The discussion below, cleaved primarily from the literature (Ref 2), is used as the backdrop for future actions.

What is a Time Capsule?

According to Ref 2:

A time capsule is a historic cache of goods and/or information, usually intended as a method of communication with people in the future. Time capsules are sometimes created and buried with much hoopla during celebrations such as a World Fair, cornerstone laying for a building or other events. They can also be unintended caches such as at Pompeii. The term “time capsule” has been in use since about 1937, but the idea is as old as the earliest human civilizations in Mesopotamia.

They can generally be classified into four types. Intentional

and unintentional (such as Pompeii), and those scheduled for retrieval on a certain date (often 10, 100, or 1000 years later), and those not.

The concept of time capsules is not recent. In the *Epic of Gilgamesh*, humanity's earliest literary work, it began with instructions on how to find a box of copper inside a foundation stone in the great walls of Uruk, and in the box was Gilgamesh's tale, written on lapis tablet. There were other time capsules 5000 years ago as vaults of artifacts hidden inside the walls of Mesopotamian cities.

In 1937, during preparations for the 1939 New York World's Fair, someone suggested burying a "time bomb" for 5000 years, a more discreet name of "time capsule" was suggested, and the name has stuck since. The 1939 New York World's Fair time capsule was created by Westinghouse as part of their exhibit. It measured 90", weighed 800 pounds, and had an interior diameter of 6.5 inches. Westinghouse named the nickel and silver alloy Cupaloy, claiming it was harder than steel.

The original capsule was followed in 1963 by a second capsule at the same site, but 10 feet to the north of the original. Both capsules are buried 50 feet below Flushing Meadows Park, site of the Fair. The first capsule contained everyday items such as a spool of thread and doll, but also a Book of Record, a vial of staple food crop seeds, and a microscope. Microfilm spools condensed the contents of a Sears Roebuck catalog, dictionary, almanac, and other texts. An RKO Pathe Pictures newsreel, 15 minutes in length, is also included.

The International Time Capsule Society (ITCS)

Reference 3 explains: "The International Time Capsule Society is an organization dedicated to tracking the world's time capsules to ensure that those that are created are not lost. Along with their database of time capsules, they have published a list of "most desired" time capsules that have been lost over the years, along with recommendations on how to build and seal a successful time capsule."

The ITCS is based at Oglethorpe University, home of the world's first successful time capsule, the Crypt of Civilization.

Summary Comments

A time capsule can have the following features:

- A time capsule can document the past or foretell the future.
- A time capsule can become lost.
- A time capsule can contain junk or decayed material.

A Simple Example of a "Time Capsule"

This brief section is an example (Ref 4) that suggests questions that should be addressed when a time capsule is being instigated. Although this is a sociological example, there is close affinity to the science, engineering, practice, and art of thermal spray.

- What do you want to tell people about yourself? What is important about your life and the times in which you live?
- What will be in the time capsule that will convey your image of your life and times? How large will it need to be?
- Will there be sculptures of humans? What size? What will they be wearing? What will they be doing?
- Will there be objects of some aspect of the culture, for ex-

ample, art, musical instruments, modes of transportation, implements of war, consumer items and job-related tools?

This example, and the many in the previous section, indicate that it is quite important to ask the right questions when it comes to planning and implementing a time capsule. Therefore, it would probably not be of lasting value to pack a few thermal spray devices (torches), books, photos, and electronic media into a chest that is then stored at some site.

Educating Younger and Future Generations in Technology

The fundamental purposes of a time capsule are (in the opinions of these authors) (a) to provide a historical framework for thermal spray and (b) to make some predictions about thermal spray for future generations.

Our audiences are several: (a) people who have made known, important contributions and who should be accorded some prominence and respect, (b) current generations who will be old-timers when the time capsule is opened, and (c) future generations, as yet unborn, who will inherit the legacies of the first two groups.

Within the framework as described above, it is pertinent to promote activities that will involve children and young adults: people less than 18 years in age. There are several websites (Ref 5) that describe how time capsules can be used as a tool to open up the awareness of school children. Thus, from the perspective of thermal spray, there are opportunities where the art and technology of thermal spray is used as a mechanism to educate children.

They are the Big Names*: An Oral History of Thermal Spraying

In 2002, the authors of this article commenced a collaboration that intended to create a process that would allow an oral history of world famous sprayers to be collected. This is not a new idea; for example, "The Caltech Archives Oral History Project began in 1978 for the purpose of recording the personal memoirs of the distinguished scientists, teachers and administrators of the Institute. To date, approximately 170 interviews have been completed and most are open to readers in transcript form" (Ref 6). The "Oral Histories Online" project of Caltech commenced in Nov 2002 and brought selected interviews to the public in digital form.

Within the area of TS, there have been at least three documented interviews: with Ballard (Ref 7), with Meyer (Ref 8), and with Muehlberger (Ref 9). This section details a methodology whereby such oral histories would be systematically collected and stored. This is a component to the concept of a historical time capsule.

Purpose

The purpose of the interviews is:

- To establish an oral history of thermal spraying by collecting oral and possibly videotaped interviews of "Big Names" in thermal spraying
- To publish these interviews in the "gossip" pages of JTST under the label "They are the Big Names ... An oral history of thermal spraying"

*The term "Big Names" is being used to denote "World Famous Sprayers."

- To use these resources in a Web-based training system on thermal spray science (*e-learning*)
- To publish these interviews completed by others of junior researchers and Ph.D. students in 2006 in a format to be defined, for example, in the ITSC2006 conference proceedings, in a special issue of JTST, in a specific book, etc.

Some Advice

Oral history (Ref 10, 11) is an interview that records a person's recollection of experiences, thoughts, and feelings about a specific event or a period of time. Some requirements concerning the major step in interviewing a person, that is, planning the interview and conducting the interview, are discussed hereafter.

Planning the Interview

- Write an introduction to your interview. Introduce yourself and recall the purpose of the interview.
- Write the questions related to the different categories depending on the information you collected. Use the resume of the person as well as your own knowledge and feeling.
- Write three warm-up questions.
- Confirm the date, hour, and place of the interview to the subject.

Conducting the Interview

- Be on time and be prepared.
- Remind the subject that the interview will be recorded and/or videotaped.
- Provide time for the person to answer questions. Be patient when answers take a long time.
- Do not argue with or correct the subject.
- Begin the interview with the introduction you prepared.
- Develop your questions. If the subject strays from the topic, try to refocus by asking one of your prepared questions.

After the Interview

- Send a thank you letter to the subject.
- Transcribe the interview tape extensively.
- Write an extended resume of the interview.

Interview Questions for Big Names

Warm-up questions:

- When you were born?
- What is your actual occupation/position?
- Would you share with us your motto?

Family background:

- Could you tell us a little bit about your family background? In which family did you grow up?
- What is your educational background?

Introduction to thermal spraying:

- When were you involved for the first time in the field of thermal spraying?
- How were you involved?

- What aroused your interest most in this technique when discovering it?

Your contribution:

- In retrospect, what constitutes from your point of view your major contribution to the science and technology of thermal spraying?
- What is your major interest or quest today?

Your vision:

- Could you please describe the principle of thermal spraying in a few words?
- Could you please describe the structure of a thermal spray coating in a few words?
- Thermal spray coating and residual stresses: what is your vision?
- What are the three critical points that have to be managed and controlled in thermal spraying?

Yesterday:

- M.U. Schoop is the original inventor of thermal spraying in 1909 (i.e., use of an enthalpy of reaction for flame spraying) and 1911 (i.e., use of the electric power for arc spraying). Please quote what constitutes for you the two other major dates (and contributors) in the development of the technique?
- Thermal spraying finds applications in numerous industrial fields. What were from your point of view the two fields that gained most from thermal spray coatings?
- Numerous functionalities can be provided by thermal spray coatings. What were from your point of view the two major improvements provided by them?
- Multiple spray guns can be chosen to manufacture a thermal spray coating. What were from your point of view the two major developments of thermal spray tools?
- Reproducibility and robustness have always been elements of concern when considering thermal spray coatings. What has been from your point of view the development that permitted an increase in quality control of thermal spray coatings most?

Today:

- Thermal spray techniques come to maturity in years 2000. What are from your point of view the two major advantages provided today by thermal spray coatings, intrinsically and compared to other coatings manufactured via other routes?
- Thermal spray coatings cannot fulfill all the requirements. What are from your point of view the two major disadvantages provided by thermal spray coatings?
- Thermal spray science exhibits eminently a multidisciplinary character. Does the education of thermal spraying seem enough developed, especially in your country/area? If not, which specific points should be increased from your point of view?

Tomorrow:

- Thermal spray techniques have evolved since M.U. Schoop and will continue to evolve in the future. What will be from your point of view the perspectives over the next 10 years in terms of: (a) industrial applications, (b) process develop-

ments, (c) market developments, (d) research developments, and (e) education?

- Concerning thermal spray tools, what should be the major technical developments over the next 10 years, from your point of view?
- What should be the major new and innovative application(s) over the next 10 years, from your point of view?
- Which area(s) of the technique from your point of view will have to be drastically improved to fulfill new requirements (i.e., economical, technical, environmental, etc.)?
- What would constitute from your point of view THE major breakthrough of the technique?

Last but not least:

- Would you develop something specifically?

Capturing the History and Future of Thermal Spray

The foregoing discussion suggests ways in which a “Thermal Spray Time Capsule” (aka “TSTC”) can be initiated. A multi-pronged approach would allow the TSTC to be developed over the coming decade.

The following components of the TSTC are proposed with participants from the TS community responsible for subtasks:

- Interview well-known personalities of TS, aka “the old timers,” while there is the opportunity. Honor these people in an appropriate fashion; for example, a special issue of JTST can be considered.
- Obtain their “recorded history” by interview through a standard set of question. The section “Some Advice” in this Commentary presents the start of “an interview manual” that can be compiled for these oral recordings to be obtained.
- Include the TSTC concept as the focus or theme for an ITSC of the future. The horizon time is of the order of 2010. The following activities could be planned under this theme:
 - ◆ Include a “Special Historical Session” at ITSC events that presents progress in materials, equipment, testing, and applications.
 - ◆ Create a special “museum of hardware” in a central location of the ITSC exhibition floor.
 - ◆ Compile a historical photo gallery of people in action throughout the ages.
 - ◆ Solicit presentations detailing company perspectives within the history of TS.
 - ◆ Include a session on TS that addresses “the future of TS.”
- Make up a classical time capsule of TS for insertion at ASM Headquarters, Materials Park, OH, for example. This major subtask would incorporate the contributions described previously. The major challenge that dictates the content of the TSTC is its physical form, dimensions, and construction material(s). The question concerning its physical location, record of its location, and the “dig up” or opening date are also a large subject for discussion.

Summary and Concluding Remarks

Within this short commentary the authors have detailed the preservation of the historical base of thermal spray. The overarching intellectual framework is presented, as well examples of activities that can be trialed. The general areas of involvement are (a) a physical artifact that represents a time capsule for future generations of thermal spray technologists, (b) an oral history project concerning the detailed recording of people who have been associated with thermal spray, and (c) a special event, to be held in conjunction with an international thermal spray conference, that memorializes thermal spray history.

The aforementioned projects are collectively identified as the thermal spray time capsule, TSTC, and they have various time scales for implementation. These long-term initiatives are based on the good will of volunteer contributors who consider this project to be fundamental to the heritage of thermal spray so that future generations have a strong sense of identity. From this perspective, every contribution is considered to be important. The authors consider that the oral history project deserves some prominence since there is a time scale that is related to the ability to interview people who may be unavailable in the near future.

The TSTC project will need both strong engagement and leadership from the TS community so that the management, organization, and promotion of this activity can progress. This support from the TS community is fundamental and, with this in mind, the authors of this article welcome remarks, comments, and suggestions.

References

1. T.H. Turner and N.F. Budgen, *Metal Spraying. The Origin, Development, and Applications of the Metal-Spray Process of Metallisation*, 1st ed., Charles Griffin and Company Limited, London, 1926, 175 pages
2. http://en.wikipedia.org/wiki/Time_capsule
3. http://en.wikipedia.org/wiki/International_Time_Capsule_Society
4. <http://collaboratory.nunet.net/cps/tsteele/chinatimecapsule.html#finalquestion>
5. http://www.eduplace.com/rdg/gen_act/growing/capsule.html
6. <http://oralhistories.library.caltech.edu/>
7. Interview, *J. Thermal Spray Technol.*, Vol 4 (No. 2), 1995, p 111-112
8. W.B. Meyer, A History of the Nooter Metallizing Department, St. Louis Metallizing Company, A JTST Historical Paper, *J. Thermal Spray Technol.*, Vol 5 (No. 2), 1996, p 215-221
9. Plasma Spraying as a By Product of the Gemini Space Capsule, *PMI J.*, Vol 23 (No. 6), 1991, p 363-365
10. http://go.hrw.com/resources/go_ss/teacher99/toolkit/TOOLKT15.pdf
11. <http://memory.loc.gov/ammem/ndlpedu/lessons/oralhist/ohguide.html>

Christopher C. Berndt
James Cook University
Townsville, Australia

Ghislain Montavon
University of Limoges
Limoges, France