

MatML

A Data
Interchange Markup
Language

This article updates and expands upon previously published information on MatML, a new extensible markup language designed specifically for the exchange of materials information. In particular, it describes the strengths of MatML from the perspective of materials specialists dealing with a wide variety of types of materials information.

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MatML is a markup language for which the tags are descriptive of materials information, e.g. <Property-Data>, <Name>, and <Units>. The MatML tagset also includes information about the pedigree of the data, as conveyed by <Metadata> and <Data-SourceDetails>. In addition, MatML, like all extensible markup languages, provides for any number of user-defined tags.

The descriptive nature and extensibility of the language renders it far more intelligible and malleable than non-descriptive fixed tagsets such as SGML and HTML. The table contains the complete tagset for MatML Version 3.0 Schema.

It should be emphasized strongly that MatML is not a suggested or required schema for any specific database or application. In fact, MatML's value stems in part from the ability to apply it readily to almost any desired schema developed for any specific application. While a valid MatML document must contain a small basic subset of tags that are composed to follow an orderly structure defined by the language, MatML is by no means rigid with regard to its application. Rather, MatML has been designed to deal with the needs of any research, development, or design concept. Therefore, specific MatML documents are likely to reflect a high degree of content variability depending upon the application.

This article describes MatML's benefits, both from the programming standpoint and from the materials specialists' vantage point. It also notes several examples of trial applications.

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Tagset for MatML Version 3.0

Associate	Geometry	PropertyDetails
AssociationDetails	Glossary	Qualifier
BulkDetails	Graphs	Relationship
Characterization	Material	Result
ChemicalComposition	MatML_Doc	Shape
Class	MeasurementTechniqueDetails	Source
ComponentDetails	Metadata	Specification
Compound	Name	SpecimenDetails
Concentration	Notes	Subclass
Data	Orientation	Symbol
DataSourceDetails	ParameterDetails	Uncertainty
DimensionalDetails	ParameterValue	Unit
Dimensions	PhaseComposition	Unitless
Element	ProcessingDetails	Units
Formula	PropertyData	Value

Material benefits of MatML

From the perspective of a materials specialist involved in any aspect of the broad range of materials research, development, production, or structural design, three features make MatML extremely attractive.

Simplicity: The inherent simplicity of MatML is based on its finite set of tags combined with the understandability of those tags, whose names are common materials terminology. It also has the flexibility to add other very detailed information through the notes and namespaces (more on these later).

Understandability: This is clearly the most important characteristic of MatML, and is provided by the fact that the tag names are conventional, standard materials terms, not cryptic, indistinct, or indiscriminate symbols as in SGML or HTML. The obvious advantages to this understandability are:

- New markup is very easy to construct.
- Incoming markup is very easy to recognize and interpret.
- Markup is readily checked for quality and completeness.

Therefore, it is very easy for the materials specialist to prepare data for exchange with other organizations and to recognize and interpret incoming markup received from other organizations. It is also relatively easy to check the completeness and quality of outgoing or incoming markup, a critical feature in cases for which the limits of the usefulness of materials data may be defined by the peripheral metadata, such as production processing, test methods, and exposure parameters.

Flexibility: MatML's ability to handle very complex numeric data, with regard to both the material description and property parameters, is essential to the materials specialist. An example is its successful application to multi-component composites. Also, as noted above, MatML has the versatility to handle

the breadth of metadata required to assure the usefulness of multi-parameter materials data.

Adding to the flexibility of MatML is the capability to include non-textual and non-numeric elements such as graphical presentations and micro-graphic representations. A significant portion of this advantage is gained by its "extensibility." This term is defined as its ability to utilize via namespaces other extensible markup languages such as SVG, which handles graphics; and MathML, which handles equations. Its extensibility enables it to work interactively with other extensible markup languages, such as femML, a markup language for finite element modeling.

Finally, through the namespace concept, MatML itself can be used as a namespace for other markup languages. For example, it may be used to cover materials in femML, the XML for finite element modeling.

Business tool: MatML is a tool for small businesses as well as for large fully integrated organizations. Businesses involved with data generation, data aggregation, database building, and database distribution are typically relatively small, and lack dedicated programming support. Therefore, the value to having the data exchange protocol readily understood by the materials specialists themselves is quite important. The simplicity and understandability of MatML makes it possible for such organizations to prepare their own information for distribution, potentially to a wide range of other groups. It also helps them deal with new information without the need for programming support.

Other applications

Applications in the early stages of consideration:

- *General Electric Corporation:* General Electric (Schenectady) is considering the application of

MatML for the exchange of some types of materials information within that organization.

- *MIL-HDBK-5, 17:* The producers of the military handbooks that cover materials information, commonly referred to as MIL-HDBK-5 and MIL-HDBK-17, have established a working group to consider the possible use of MatML in their exchange of materials information.

- *Automated Equipment Information Exchange (AEX/FIATECH):* AEX/FIATECH is developing a materials markup for automated equipment information exchange. Like MatML, English language tags are utilized, but unlike MatML, each property requires different tags. When the AEX program is at a comparable stage of development with MatML, consideration may be given to harmonization.

Markup software

While much advantage is gained by the simplicity, understandability, and flexibility of MatML, a major step toward its broader implementation will come with the availability of software to facilitate the markup process. Even for someone quite familiar with the data, the markup process can be tedious and repetitious, and will be greatly facilitated by editing software that improves the efficiency and cost-effectiveness of the markup effort.

Even with such software tools, it is likely that some "human intervention" will be required to markup a complex set of data, e.g., some interpretation of unusual elements of data such as prior exposure conditions or unusual processing of the material. In addition, interpretation may be needed to handle variations in terminology, a familiar problem that may be enhanced by incorporating thesaurus software into the formatting software.

The ultimate goal is to have many, possibly all, providers and consumers of materials information using MatML to exchange materials data. That would enable any company to accept data from any source and facilitate its flow into any internal system without the need to write new programs. It would transform the current situation, in which it is almost always necessary to write new software programs for each source.

Additional collaborations

Although many trial applications of MatML are already underway and others are being considered, the addition of new opportunities would be welcomed, especially in markets or applications not yet engaged. Ideal trials to consider are exchanges of representative sets of materials information between parties for whom this is a routine activity. Even more beneficial for trials would be situations in which regular data exchange would be routine if more cost-effective means could be established. It is in such cases that MatML might have its biggest impact. ■

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MatML was developed under the leadership of E.F. Begley at NIST with the support and involvement of a broad range of industry and academic partners. The current status and implementation may be found at <http://www.matml.org>.

TRIAL APPLICATIONS

To support an awareness and understanding of MatML and its applications, the www.matml.org website, hosted by Automation Creations Inc., has been launched containing the entire Version 3.0 schema, and markup examples illustrating its application.

With the help of the original MatML Steering Committee, now replaced by the MatML Coordination Committee, the seeds of several trial applications have been planted in several important data-intensive industries:

- *ACI Application to MatWeb Materials Information Downloads:* Automation Creations Inc. (ACI) has a trial export format for MatWeb in place, and is fully committed to MatML as an option for distributing materials information from the site.

- *Granta Design Application of MatML:* Granta Design is working on a trial application with which users might eventually download materials information in MatML format using Granta Design software.

- *Granta Design Application of MatML for NIST MSEL:* On contract from the NIST Materials Science and Engineering Laboratory, Granta Design is working on the use of MatML for the distribution of materials information by MSEL's Metallurgy Division.

- *Laboratory Test Equipment Application of MatML:* A Test Data Exchange Working Group has been established to evaluate the reporting of materials information from laboratory test equipment to lab customers using MatML. Westmoreland Mechanical Testing & Research (WMTR) will utilize sample customer orders requesting data in MatML as the output.

- *ASM/MSO Application of MatML for Publication Development:* ASM International and MSO Software are evaluating MatML to handle the transmission of materials information from ASM to MSO for the development of new ASM publications.