Supplementary information

Annotated guidelines

1.Annotation object

1.1 Requirements for annotating documents

It mainly studies the correlation between the composition, structure, structure and properties of alloys in the spray deposition experiment of aluminum-silicon alloys, and analyzes and sorts them out. The material science literature selected in this paper is the relevant material literature of the aluminum-silicon alloy spray deposition experiment, and the literature format is PDF.

1.2 Annotate the content of the documents

The scientific literature contains a title, an abstract, a body, and a reference. The collection and annotation of the title can prepare for the subsequent work, and the material entities to be identified and the entity relationships to be extracted in the literature are mainly contained in the abstract and the text. Therefore, only the title, abstract and body of the literature are considered to be annotated, and the references are not considered to be annotated, i.e., the data set does not contain the contents of the references in the literature of aluminum-silicon alloy materials.

2. Annotation tools

Use BRAT to annotate document text. Commonly used sequence annotation methods include BIO, BIOSE, IOB, etc., and we use standard BIO annotation methods.

3. Task description

The annotation content focuses on four parts: alloy composition, experimental process, test results and parameters of aluminum-silicon alloys in the jet deposition experiment. Among them, after the experiments are completed to test the performance of the product, Table 1 shows some of the properties of the aluminum-silicon alloy that are of major concern.

4. Entity type

In the text of the aluminum-silicon alloy spray deposition experimental literature, it is necessary to pay attention to the composition of the alloy under study, the experimental process and the final test results, etc., and the following four parts of

Table 1 Some of the properties of aluminum-silicon alloys are mainly concerned

performance	abbreviation
tensile strength	UTS/Rm/σ_b
elongation	EL/δ
Vickers hardness	HV
Brinell hardness	HB
Rockwell hardness	HR
transmission electron microscope	TEM
scanning electron microscopy	SEM
optical microscope	OM
electron back scattering diffraction	EBSD
Coefficient of thermal expansion	CTE
Wear rate	WR
Friction coefficient	FC
Wear way	WW
Grinding pairs	GP
Load	
Sliding distance	SD

information will be marked:

Part I: Alloy composition. The alloy material studied is summarized in the materials literature, including the constituent elements and the content of the elements. Among them, the content is expressed in two ways: mass percentage and content percentage.

Part II: Experimental process. We mainly focus on the spray deposition experiment of aluminum-silicon alloys, and the annotated experimental content includes the steps of each experiment in the jet deposition experiment and the final experimental results.

Part III: Test results. The test part is to test the performance of the product after the completion of the experiment, mainly marking the test name, test value, test chart, and phase.

Part IV: Parameters. The parameter part is mainly the parameter name and parameter value contained in the experimental process and the test process.

We first identified 11 entity types, which fall into the four sections above. The first

part of the alloy composition includes three solid types: element, content and alloy; The second part of the experimental process includes two types of entities: experiment and experimental results; The third part of the test results includes four entity types: test name, test value, test chart and phase; The fourth part of the parameter contains two entity types, namely the parameter name and the parameter value.

Table 2 lists the entity types to be labeled and their corresponding annotation formats.

Table 2 The type of entities

Entity types	**Entity**	**Annotation format**
alloy composition	element	Ele
	content	Con
	alloy	Alloy
experimental process	experiment	Exp
	experiment_result	Exp_r
parameters	parameter_name	Par_n
	parameter_value	Par_v
test results	test_name	Test_n
	test_value	Test_v
	test_image	Test_f
	phase	Phase

5. Relationship types

After identifying 11 entity types, 13 types of intra-sentence relationships and 1 type of inter-sentence relationships are defined. Intra-sentence relationships are divided into 4 types of relationships, namely ingredients, experiments, tests, and parameters.

The first type of relationship: ingredients. Including content - element, element - alloy two relationships;

The second type of relationship: experimental. Including alloy - experiment, experiment - experimental result, experiment - parameter name, experimental result - parameter name 4 relationships;

The third type of relationship: testing. Including alloy - test name, test name –

parameter name, test name - test chart, test name - test value, test name - phase, phase - test value 6 relationships.

The fourth type of relationship type: parameters. Include parameter name - parameter value 1 relationship.

Table 3 describes the relationships and annotation formats that need to be annotated.

Table 3 The type of relationship between entities

Relationship types	**Relationship**	**Entity 1**	**Entity 2**	**Annotation format**
component	content--element	content	element	Con-Ele
	element--alloy	element	alloy	Ele-Alloy
experiment	alloy--experiment	alloy	experiment	Alloy-Exp
	experiment--experiment_result	experiment	experiment_result	Exp-Exp_r
	experiment_result--parameter_name	experiment_result	parameter_name	Exp_r-Par_n
	experiment--parameter_ name	experiment	parameter_name	Exp-Par_n
test	alloy--test_name	alloy	test_ name	Alloy-Test_n
	test_name--parameter_name	test_name	parameter_name	Test_n-Par_n
	test_name--test_value	test_name	test_value	Test_n-Test_v
	test_name--test_image	test_name	test_image	Test_n-Test_f
	test_name--phase	test_name	phase	Test_n-Phase
	phase--test_value	phase	test_value	Phase-Test_v
parameter	Parameter_name—parameter_value	parameter_ name	parameter_value	Par_n-Par_v

Number of annotators and Fleiss Kappa

There are four annotators, they are Dan Hu, Changhui Yao, Ruigang Wu, Jiancheng Yin. The Fleiss Kappa index calculated for the Al–Si alloy entity–relation extraction dataset was 0.71 which indicated the ‘substantial agreement’.