

Suppression of Iron Silicide Formation in the Reaction Layer of Sialon – 7.5% Cr Ferritic Steel Joint

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Abstract. Diffusion bonding of sialon and 7.5%-Cr Ferritic Steel (FS) in as-received and nitrided condition was studied. Decomposition of sialon and interdiffusion of elements between the sialon and the steel was observed. The interdiffusion of elements produced reaction layers at the joint. The steel moved into the decomposition part of the sialon and replaced the decomposed sialon in this part. Diffusion of silicon into the steel resulted in the silicon-diffusion layer. FeSi_2 was formed in the reaction layer when Si in the decomposition part of the sialon reacted with Fe. The use of nitrided steel in the diffusion bonding had suppressed the formation of the FeSi_2 in the layer.

Introduction

Reaction layers are usually formed in the joint of ceramic-steel produced by diffusion bonding. The interdiffusion of elements resulted in reaction products which may or may not harm the joint. Silicides are one of the compounds that may be formed in the reaction layer of silicon-based ceramic – metal joint. The compounds are brittle and have different crystal structure with Fe-metal [1]. Therefore, the formation of the compound should be prevented.

The silicide was not formed in the reaction layer of Si_3N_4 joined with Fe or Fe alloy [1, 2]. It was not found either in the reaction layer of sialon – steel [3]. However, silicides were identified in the joining of Si_3N_4 with austenitic stainless steel [4, 5]. Formerly, brittle reaction layers were noticed in the joining of the similar materials [6]. Metal silicide also decreased the strength of ceramic and Ti joint [7, 8]. Hence, suppressing the silicide formation could improve the joint. Suppression of the FeSi_2 formation was demonstrated in the joining of Ti and Si_3N_4 by using nitrogen pre-solved treatment on the Ti prior to joining [7].

The present work investigates the diffusion bonding of sialon (Si-Al-O-N), an engineering ceramic, with 7.5%-Cr Ferritic Steel (FS). Former work recognized the reaction layers at the joint of the sialon with the steel in as received condition [9]. Yet, phase identification on the joint had not been accomplished. In this study, analysis on the phases of the reaction layers of the joint was carried out. Diffusion bonding of the sialon was also conducted with the steel in nitrided condition. This was to study the influence of nitrogen in the steel prior to the diffusion bonding. Formation of the reaction layers and the reaction product was scrutinized. Solution nitriding was applied on the steel to diffuse the nitrogen prior to the diffusion bonding. The joint was characterized using field emission scanning electron microscopy (FESEM), energy dispersive X-ray (EDX) attached to the FESEM, X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS).

Experimental Procedure

The sialon material was α -sialon provided by Syalon Int. Ltd., UK in the form of discs of 19 mm diameter and 4 mm thickness. The steel was 7.5%-Cr FS in the form of 16 mm diameter rod. Tables 1 and 2 present the chemical compositions of the sialon and the steel, respectively.

Diffusion bonding was carried out using Korea Vac hot press machine of Advance Materials Research Centre (AMREC), Sirim Bhd., Malaysia. The steels to be joined were in as received and

nitrided for four hours conditions. Nitriding for the steel prior to the diffusion bonding has been reported elsewhere [10]. The steel was cut into 1.5 mm thickness and polished with 1 μm diamond paste. They were then washed with acetone in an ultrasonic cleaner and dried with a hot air dryer. Joining was performed in sandwich formed where a steel sample was placed in between the two sialon discs. The samples were introduced into the furnace and embedded in boron nitride powder to avoid contact between the steels and the graphite dies set. Uniaxial pressure of 20 MPa was applied while the samples were heated to 1200°C and hold for one hour under vacuum condition of 2×10^{-5} Torr. Heating and cooling rate of the furnace were set at 5°C/minute to avoid thermal shock. The pressure was released when cooling was started.

Table 1. Chemical compositions of sialon [weight percent]

Al	O	N	Si
3.57	2.87	1.58	Balance

Table 2. Chemical composition of as supplied 7.5% Cr FS [weight percent]

C	Cr	Mo	Ni	S	Si	Mn	V	Fe
0.06	7.51	0.69	0.87	0.002	0.32	0.64	0.29	Balance

The diffusion bonded samples were cross sectioned using precision diamond cutter. The cross section surface was ground with diamond grinding discs continued with 600 grade emery papers and polished with 6 μm , 3 μm and 1 μm polycrystalline diamond paste. Vilella etching reagent was used for the sample preparation. Microstructure of the joint was observed using FESEM where EDX analysis was also carried out simultaneously. XRD and XPS examinations were applied on the surface of the reaction layer. For this purpose the diffusion bonded sample was broken to expose the layer surfaces. The examination was then conducted on the surface of the steel from the fractured sample.

Results and Discussions

Diffusion bonding of the sialon with the steels was successfully achieved. Good and sound joint was attained and is shown in the scanning electron micrograph of the joint cross-section (Fig. 1). Two reaction layers were formed at the interfaces. The first was an irregular thin layer adjacent to the sialon, while the second one was thicker and extended into the steel. For the rest of the discussion, terminology of interface layer was used for the first layer, while the later will be called as diffusion layer.

Light precipitates were found throughout the interface layer. This is expected as the reaction product of the sialon with the steel. Whereas, the morphology of the second layer indicated that it was a single phase. In the parent steel, ferritic structure of the as-received samples changed to martensite during the diffusion bonding. Nitrogen diffusion had driven the martensite transformation as it was established in the previous work [10, 11]. Therefore the martensite in this case showed an evidence of the nitrogen diffusion into the area. However, in the sialon – nitrided steel joint, the martensite was also formed in the initial nitrided structure of the steel.

Fig.2a and 2b depict the interdiffusion of elements from the sialon to the steel and vice versa. Sialon decomposed in the interface layer. The decrease of the sialon's elements in this area implied this phenomenon. Silicon was released from the sialon and diffused into the steel. In the sialon – as received steel joint, the silicon reached approximately 60 micron into the steel. It produced the diffusion layer that comprised Fe, Cr and Si. In the joint of the sialon with the nitrided steel, the silicon diffusion distance in the steel was approximately 40 micron. This was shorter than the silicon diffusion distance in the former diffusion bonding. This might suggest that the nitrided steel had reduced the silicon diffusion into the steel.

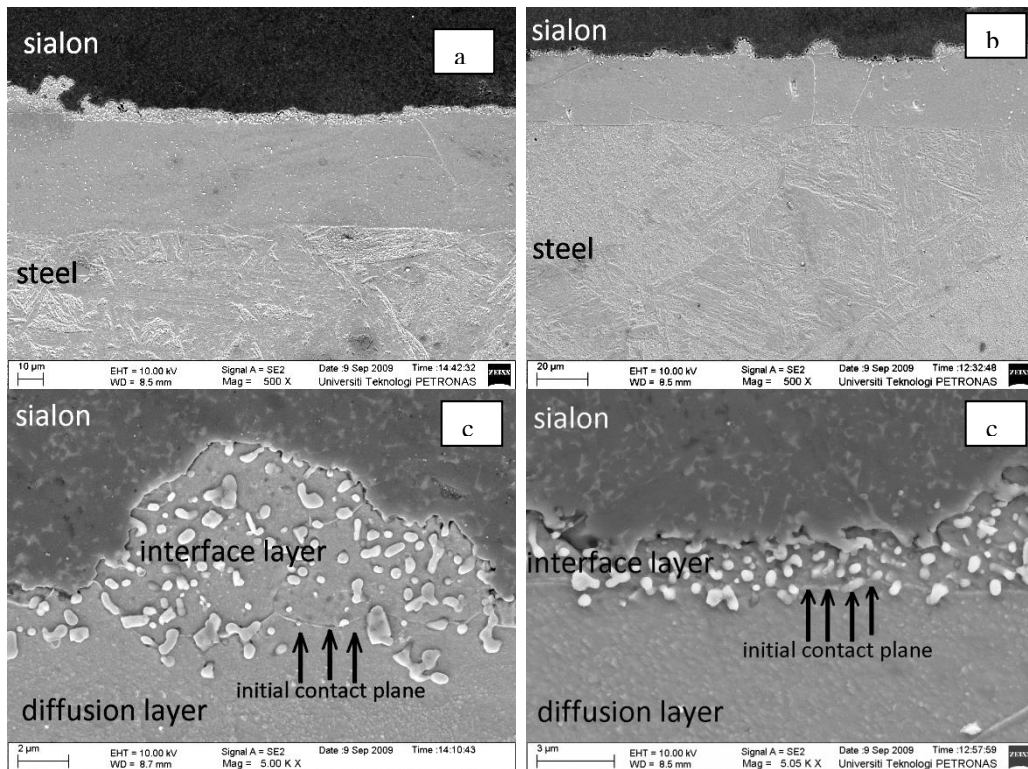


Fig. 1. (a) Cross section of the overall sialon-as received FS joint, (b) Cross section of the overall sialon-nitrided FS joint, (c) the interface layer of sialon diffusion bonded with as-received and (d) the interface layer of sialon diffusion bonded with nitrided 7.5%-Cr FS .

Fe and Cr in the interface layer indicated the diffusion of steel's elements into the sialon and this is shown in Fig. 2. Previous works [2, 3, 5] have recognized that the initial contact of the materials in the diffusion bonding was at the border between the two reaction layers (refer to Fig. 1). This revealed that the interface layer is in the sialon's part. Therefore, the presence of the steel's elements in this part is the evidence of the element diffusion into the sialon. Domination of Fe in this area depicted more-intense diffusion of the steel's elements into the sialon. However, the diffusion of the elements was limited to the decomposed part of the sialon. This is indicated by the absence of the steel's elements in the original sialon.

Analysis of elements was carried out on the several precipitates in the interface layer. Higher concentration of Si in the interface layer of the sialon joined with the as-received steel could be highlighted (Table 3a). In this joint, the precipitates contained maximum of 29.71 weight percent. This is much higher than the Si in the precipitates of the joint of sialon with the nitrided steel (i.e. maximum of 5.73 weight percent).

With the high content of Fe and Si in the precipitates, formation of iron silicides might be expected. This was revealed by the XRD examination attempted on the interface layer surface. The XRD pattern from the interface layer of the sialon diffusion bonded with the as-received steel shows the presence of $FeSi_2$ (Fig.3). Ferrite (α) phase that appeared from the matrix of the layer was also observed. Other than Fe, the matrix also contains Cr and Si that are both ferrite formers [2]; therefore, the phase in the layer matrix is most probably ferrite solid solution with dissolved Cr and Si.

XRD only detected the ferrite phase in the interface layer of the sialon – nitrided steel joint. This was from the matrix layer. Evidently the iron silicide was not formed. Concentration of Si in the precipitates was relatively low. Hence, the XRD result agreed with the elemental analysis of the precipitates in the joint.

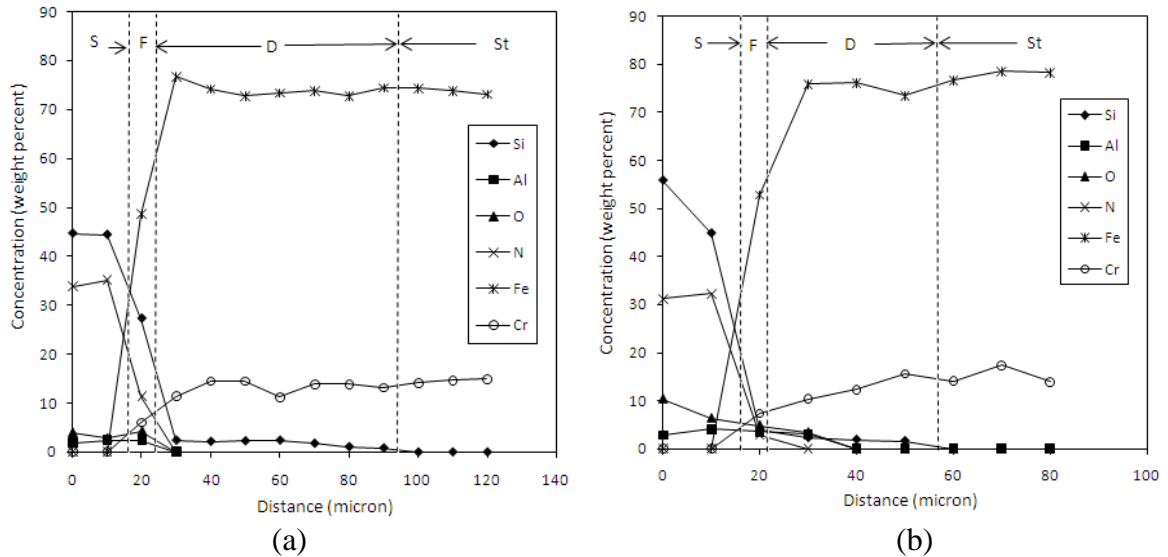


Fig. 2. Concentration profile of elements across the joint of sialon diffusion bonded with 7.5%-Cr FS in (a) as received and (b) nitrided for four hours; S=sialon, F=interface layer, D=diffusion layer; St=steel

Table 3. Concentration of elements of the precipitates [weight percent] in the interface layer of sialon diffusion bonded with (A) as-received and (B) nitrided 7.5%-Cr FS

No	Cr	Fe	Si	O	Al	Y	N
1	0.72	48.47	29.71	2.23	4.91	0	13.96
2	8.56	48.44	26.64	2.30	3.30	0	10.76
3	5.42	49.04	27.37	2.33	4.61	0	11.23
4	7.43	48.37	26.35	2.81	4.31	0	10.72
5	7.75	48.79	26.61	2.41	4.20	0	10.25

No	Cr	Fe	Si	O	Al	Y	N
1	7.51	35.54	5.73	22.05	9.65	19.53	0
2	4.44	65.98	4.38	10.33	5.75	9.11	0
3	15.74	80.08	4.18	0	0	0	0
4	19.32	76.86	2.78	0	1.05	0	0
5	18.69	79.06	2.25	0	0	0	0

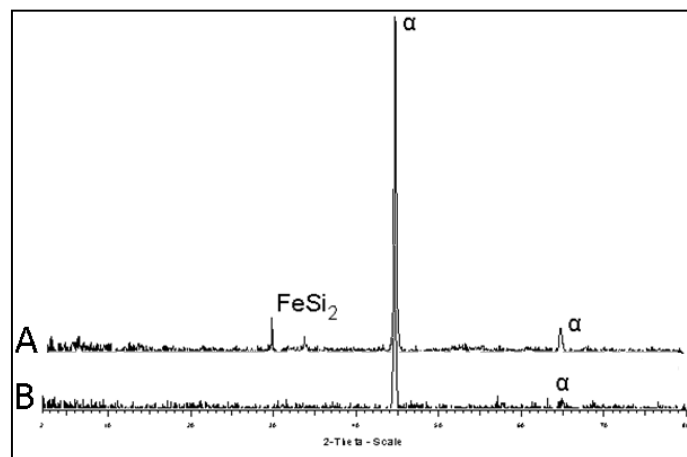


Fig.3. XRD pattern from the surface of the interface layer in the sialon diffusion bonded with (A) as-received and (B) nitrided 7.5%-Cr FS

FeSi₂ in the interface of sialon – as-received steel joint was also revealed by the XPS spectra from the layer (Fig.4a and 4b). This was represented by the peak at 706.92 eV and 719.96 eV that correspond to FeSi₂ [12-15]. Based on the same references, two other peaks at 711.08 eV and 724.58 eV were attributed to Fe_{2p3/2} from Fe₂O₃. The presence of plasmon loss at around 730 eV in the Fe_{2p} spectra indicates the peak of FeSi₂ [13, 14].

The Fe spectra given for the sialon – nitrated steel was very similar (Fig. 4c). Fe in the form of Fe_2O_3 is indicated by the peaks at 711.29 eV and 724.48 eV, respectively. Two peaks at 706.81 eV and 719.8 eV could attribute to $\text{Fe}_{2p_{3/2}}$ peak in the metallic Fe or FeSi_2 . However, plasmon loss was not indicated in the spectra. Therefore those peaks did not correspond to FeSi_2 . It rather represents the Fe in metallic form, since the peak of the chemical states is not much different with the the peak of Fe in FeSi_2 formed, i.e. less than 0.5 eV [13].

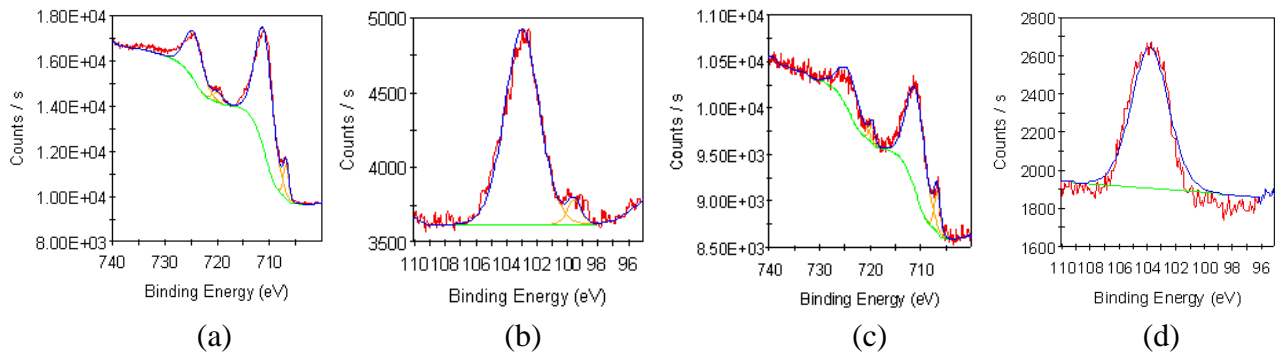


Fig.4. XPS spectra of (a) Fe and (b) Si in the interface layer of sialon – as-received steel and (c) Fe and (d) Si in the interface layer of sialon – nitrated 7.5%-Cr FS

In XPS spectra of Si, FeSi_2 is indicated by the peak at 99.58 eV (Fig. 4b), while the peak at 102.98 eV is Si_{2p} from SiO_2 [13-15]. In the other joints, only one peak was shown (Fig. 4d). This is at 103.83 eV which is closed to the peak of Si_{2p} from SiO_2 . Therefore, the XPS results confirmed that the FeSi_2 was formed in the joint of the sialon – steel. This also revealed that the iron silicide did not present in the interface layer of the sialon – nitrated steel joint. These are in good agreement with the XRD and the EDX analysis.

The above characterizations proved that the reaction of sialon and as-received 7.5%-Cr FS produced FeSi_2 in the joint interface. They also disclosed that the silicides formation was suppressed in the joint of the sialon with the nitrated steel. Since FeSi_2 is brittle, the nitriding pre-treatment on the steel could potentially improve the sialon – steel joint by suppressing the formation of iron silicide.

In summary, sialon decomposed and released Si and N during the interaction with the steel at the diffusion bonding temperature. Both elements diffused into the steel. Silicon diffused into the steel and produced a diffusion layer. Nitrogen diffusion also occurred across the reaction layers. It stimulated the formation of martensite in the parent steel. In the diffusion bonding of the sialon with the as-received steel, more silicon at the sialon-decomposition part reacted with Fe from the steel and precipitated as FeSi_2 . However, nitrated steel used in the diffusion bonding has suppressed the formation of the silicides in the layer. It seems that in this condition more Fe was transferred from the steel into the sialon leading to less concentration of Si in the layer. When reacts with Fe, the composition of Si in the layer might be insufficient to form the silicides. Consequently the formation of the iron silicides was hindered.

Conclusion

During the diffusion bonding with 7.5%-Cr FS, sialon decomposed and liberated silicon and nitrogen that subsequently diffused into the steel. Diffusion layer in the steel was resulted due to the silicon diffusion. Nitrogen also diffused into the steel and formed martensite. The steel's element diffused in significant quantity into the sialon and filled up the sialon-decomposition area to produce the interface layer. FeSi_2 precipitated in the interface layer. This is the reaction product of the sialon and the as-received steel during the diffusion bonding process. The used of the nitrated steel has been proven to suppress the formation of FeSi_2 in the interface layer of the joint with sialon. Thus, the brittle fracture at the joint can be avoided.

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References

- [1] E. Heikinheimo, I. Isomaki, A. A. Kodentsov and F. J. J. van Loo: *Journal of European Ceramic Society*, Vol. 17 (1997), pp. 25 – 31
- [2] F.J. Oliveira, R.F. Silva and J.M. Vieira: *Bol. Soc. Esp. Cerám. Vidrio*, Vol. 39 (6) (2000) pp. 711-715
- [3] J. Vleugels, L. Vandeperre and O. Van Der Biest: *Journal of Materials Research*, Vol. 11 (5) (1996)
- [4] R. Polanco, A. De Pablos, P. Miranzo and M.I. Osendi: *Applied Surface Science*, Vol. 238, (2004), pp. 506–512
- [5] P. Poza, P. Miranzo and M.I. Osendi: *Thin Solid Films*, Vol. 517 (2008), pp. 779–781
- [6] B.T.J. Stoop and G. Den Ouden: *Metallurgical and Materials Transactions A*, Vol. 26A (1995), p. 203
- [7] M. Maeda, R. Oomoto, M. Naka and T. Shibayanagi: *Trans. JWRI*, Vol. 30, n. 2 (2001)
- [8] J.L. Ruiz, E.B. Becerril and J.G.F. Lopez: *Revista Mexicana De Fisica*, Vol. S 55, n. 1 (2009), pp. 25-29
- [9] H. Firmanto, P. Hussain, and O. Mamat in: *Interface layer of the diffusion bonded sialon and high chromium steel*, in *Proceeding of the 2nd International Conference on Plant Equipment and Reliability*, Kuala Lumpur, Malaysia (2010)
- [10] H. Firmanto, P. Hussain, A.M. Abdul Rani and O. Mamat in: H. Firmanto, P. Hussain, A.M. Abdul Rani and O. Mamat in: *Microstructure and hardness of 9% ferritic stainless steel nitrated at high temperature*, in *Proceeding of the 6th International Materials Technology Conference & Exhibition*, Kuala Lumpur, Malaysia (2008)
- [11] H. Mitsui and S. Kurihana: *ISIJ International* Vol. 47, n3 (2007), pp. 479–485
- [12] K. Rührschopf, D. Borgmann and G. Wedler: *Thin Solid Films*, Vol. 280 (1996), pp. 171-177
- [13] T. Saito, H. Yamamoto, M. Sasaseb, T. Nakanoya, K. Yamaguchi, M. Haraguchi and K. Hojou: *Thin Solid Films*, Vol. 415 (2002), pp. 138–142
- [14] H. Qi, C. Qian and J. Liu: *Nano Letters*, Vol. 7, n. 8 (2007), pp. 2417-2421
- [15] C.D. Wagner, W.M. Riggs, L.E. Davis, J.F. Moulder and G.E. Muilenberg in: *Handbook of X-ray photoelectron spectroscopy*, Perki-Elmer Corporation, Physical Electronics Division, Minnesota, USA (1979)



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Preface

This special issue of Defect and Diffusion Forum contains selected refereed papers presented at the Sixth International Conference on Diffusion in Solids and Liquids (DSL-2010) held at the Hotel Concorde La Fayette Paris, France during the period 5th-7th July, 2010.

The goal of the conference was to provide a unique opportunity to exchange information, to present the latest results as well as to review the relevant issues on contemporary diffusion research. Young scientists were especially encouraged to attend the conference and to establish international networks with well-known scientists.

Several topics were highlighted in the scope of special sessions and some of the presented papers are collected in this volume: *Characterization and Properties of Hard Coatings* (by I.E. Campos Silva, R.E. Galindo), *Diffusion, Permeability and Gas Dissolution in Polymers and Polymer Foams* (E. Solórzano Quijano, M. Angel Rodríguez Pérez), *Grain Boundaries and Interfaces: Structure, Thermodynamics and Diffusion Properties* (V.V. Popov, B. Straumal), *Active Biomaterials and Tissue Engineering* (N. Jessel, A. Bianco, V. Ball), *Carbon and Oxide Based Nanostructured Materials* (N. Yahya, M. Rusop Mahmud, K. Koziol), *Diffusion in Solid Ionic Conductors* (P. Heitjans, G.E. Murch, I. Belova), *Heat and Mass Transfer in Porous Media* (J.M.P.Q. Delgado), *Microstructural Development of Metallic Materials Through Diffusion Controlled Processes* (Y. Houbaert, L. Suárez, P. Rodríguez), *Hydrogen-Related Kinetics in Materials* (Y. Fukai, M. Wilde) and *Computational Heat and Mass Transfer: New Approaches and Innovative Schemes* (R. Bennacer, M. EL Ganaoui, L. Tadrist).

More than 340 scientists and researchers coming from more than 56 countries attended the conference. The large number of presented papers emphasises the considerable academic and industrial interest in the conference theme. The editors wish to thank the authors and delegates for their participation and cooperation, which made this sixth conference especially successful.

Finally, we wish to express our warm thanks and appreciation to our colleagues and associates for their sustained assistance, help and enthusiasm during the preparation of the conference.

The seventh conference, DSL-2011, will be held in Algarve, Portugal, from 27-29 June, 2011 (<http://www.dsl2011-algarve.com/>).

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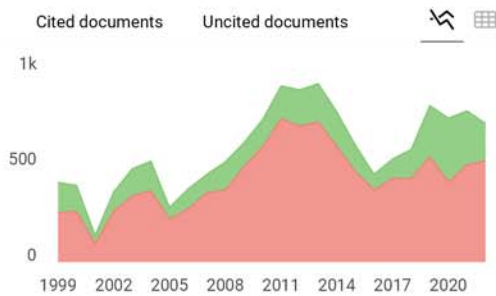
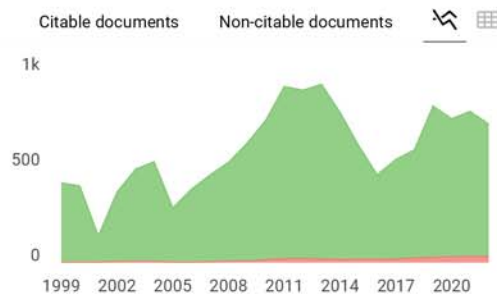
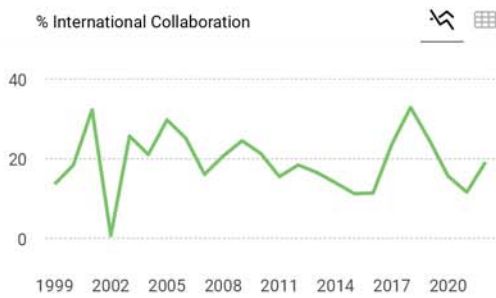
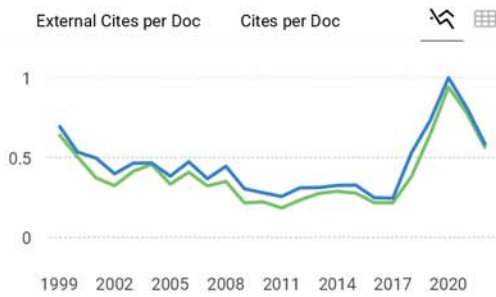
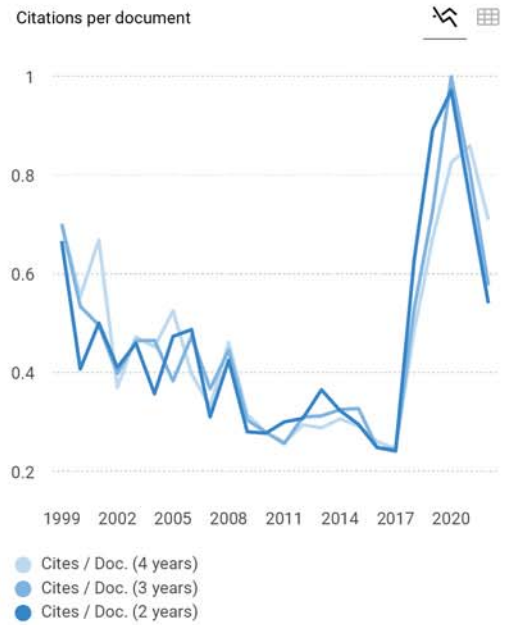
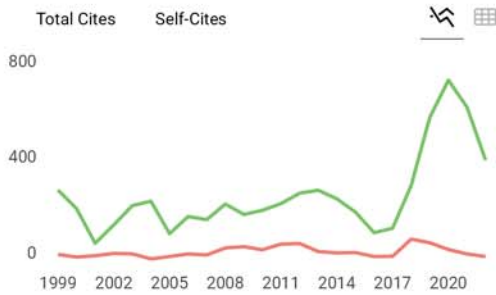
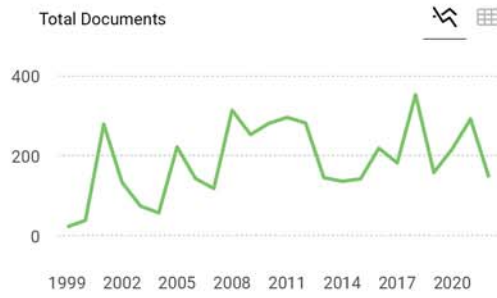
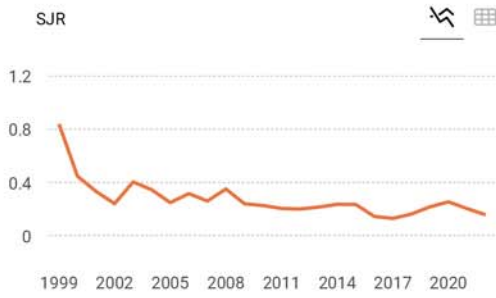
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A **Arun Sankar V V** 12 months ago

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reply



Melanie Ortiz 12 months ago

SCImago Team

Dear Arun,

Thank you very much for your comment.

All the metadata have been provided by Scopus /Elsevier in their last update sent to SCImago, including the Coverage's period data. The SJR for 2021 was released on 11 May 2022. We suggest you consult the Scopus database directly to see the current index status as SJR is a static image of Scopus, which is changing every day.

The Scopus' update list can also be consulted here:

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Best Regards, SCImago Team

A **Andrei Iliescu** 3 years ago

Dear Sir,

Would you be so kind to tell me about the Impact Factor between 2017-2020

Thanking you in advance,

Best regards,

Prof.Andrei Iliescu

reply



Melanie Ortiz 3 years ago

SCImago Team

Dear Andrei, thank you very much for your comment. SCImago Journal and Country Rank uses Scopus data, our impact indicator is the SJR (Check it on our website). We suggest you consult the Journal Citation Report for other indicators (like Impact Factor) with a Web of Science data source. Best Regards, SCImago Team

N **Nguyen Hoc Thang** 4 years ago

Defect and Diffusion Forum has three kinds of ISSN numbers: ISSN print 1012-0386; ISSN web 1662-9507; ISSN cd 1662-9515 as known in <https://www.scientific.net/DDF/Details>

Can you please list all of the ISSN numbers into this web (Now, it has only one of ISSN 1012-0386)

Thanks

reply



Melanie Ortiz 4 years ago

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